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Alexithymia, Reward Sensitivity and Risky Drinking: The Role of Internal Drinking Motives

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Abstract

Two personality dimensions, alexithymia and reward sensitivity, are known risk factors for problematic alcohol consumption. Internal or mood-change motives of drinking to cope with negative mood, as well as drinking to enhance positive mood ("get high"), have also been implicated as risk factors. The present study sought to determine whether the association between alexithymia and risky drinking is mediated by the motive of drinking to cope with negative mood, and whether the association between reward sensitivity and risky drinking is mediated by the motive of drinking to enhance positive mood. Social drinkers aged 18-45 years were recruited from an Australian university and the local community, with the final sample consisting of 155 participants (80 females, 75 males). They completed an online questionnaire battery that included the Toronto Alexithymia Scale (TAS-20), Depression Anxiety Stress Scales 21 (DASS-21), Drinking Motives Questionnaire – Revised (DMQ-R), Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ), and Alcohol Use Disorders Identification Test (AUDIT). The positive relationship between TAS-20 alexithymia and AUDIT index of risky drinking was mediated by coping motives for drinking, with the relationship of TAS-20 to the latter mediated by negative mood as indexed by DASS-21. Further, the positive relationship between SPSRQ sensitivity to reward scores and AUDIT was mediated by enhancement motives for drinking. Although results were obtained in a non-clinical sample, they are consistent with the differential drinking motives said to characterize Cloninger's (1987) Type I versus Type II alcoholism and suggest distinct trajectories from inherent personality traits to problematic drinking.

Australia is a high alcohol consuming country by world standards, and excessive alcohol use contributes to the burden of mortality through its association with chronic physiological and psychological illnesses (Australian Bureau of Statistics, 2012). Identification of factors influencing risky alcohol consumption is of crucial importance if strategies to limit alcohol-related harm are to be implemented. In addition to sociocultural factors, certain personality traits have received considerable research attention for their purported roles in promoting risky or harmful drinking. Recent evidence is especially strong for two such traits, reward sensitivity and alexithymia, as major risk factors for problematic drinking (e.g., Dawe, Gullo, & Loxton, 2004; Kambouropoulos & Staiger, 2004; Lyvers, Czercyk, Follent & Lodge, 2009; Thorberg, Young, Sullivan & Lyvers, 2009). Alexithymia is a personality trait (see Thorberg et al., 2016a) characterised by difficulty identifying and describing feelings and an externally oriented thinking style (Taylor & Bagby, 2000), whereas reward sensitivity refers to the tendency to pursue sources of positive reinforcement and to experience positive emotions when rewards are obtained (Dawe & Loxton, 2004). Such traits are presumed to promote heavier alcohol consumption via the more proximal influences of drinking motives (Bruce, Curren, & Williams, 2012; Franken & Muris, 2006; Crutzen, Kuntsche & Schelleman-Offermans, 2013; Lyvers, Hasking, Albrecht, & Thorberg, 2012; Lyvers, Hasking, Hani, Rhodes & Trew, 2010; Staiger, Kambouropoulos, & Dawe, 2007).

One of the factors differentiating Cloninger's (1987; Cloninger, Sigvardsson & Bohman, 1996) influential typology of alcoholism into Types I and II is the primary motive for drinking, with negative reinforcement (e.g., drinking to alleviate anxiety or depression) characteristic of Type I, related to trait neuroticism, and positive reinforcement (e.g., drinking to "get high") characterizing Type II, related to trait impulsivity. Recent evidence implicating reward sensitivity – a dimension of impulsivity (Dawe et al., 2004) - as a risk factor fits well

with Cloninger's Type II concept, whereas the risk factor of alexithymia fits with Cloninger's Type I given the strong association of alexithymia with the negative mood states of anxiety and depression and anxiety sensitivity as reported in both alcohol-dependent and non-clinical samples (e.g., Cox, Blount, & Rozak, 1998; de Timary, Luts, Hers & Luminet, 2008; Lyvers, Kohlsdorf, Edwards & Thorberg, 2017; Thorberg et al., 2009).

Alcohol expectancies refer to an individual's positive and negative beliefs regarding the consequences of consuming alcohol, whereas drinking motives refer to the basic psychological drives underlying a person's decision to drink (Bruce et al., 2012). Outcome expectancies lead to the formation of drinking motives (Cox & Klinger, 1988). For example, if an individual holds the belief that alcohol will relieve stress, they should be more inclined to drink as a coping mechanism. Drinking motives are thus more proximal to alcohol use and abuse than are alcohol expectancies (Kuntsche, Stewart, & Cooper, 2008; Stewart & Devine, 2000). Cox and Klinger (1988) developed a categorical model of drinking motivation based on two underlying dimensions, valence and source. Valence (positive vs. negative) refers to drinking either to achieve a positive outcome or avoid a negative one, whereas source (internal vs. external) refers to whether the outcome sought is internal (e.g., mood change) or external (e.g., social approval). These two dimensions combine to form four primary drinking motives: enhancement (EnhM; positive, internal), social (SocM; positive, external), coping (CopM; negative, internal) and conformity (ConM; negative, external). EnhM and CopM are both associated with drinking to achieve an internal outcome (i.e., alter the drinker's emotional state), however the former aims to induce or enhance a positive mood state of euphoria, whereas the latter aims to suppress or alleviate a negative mood state such as anxiety or depression. EnhM are thus linked to drinking in response to urges, temptations and pleasant emotional states (Theakston, Stewart, Dawson, Knowlden-Loewen, & Lehman, 2004), whereas CopM are linked to drinking alone, during or following conflict with others,

and in response to unpleasant emotional states (Feil & Hasking, 2008). Stewart and Devine reported that the internal motives, EnhM and CopM, were significant predictors of risky drinking, suggesting that individuals who primarily drink for internally motivated reasons are at elevated risk of alcohol-related problems. Subsequent work has supported associations of EnH and CopM with heavier drinking and drinking-related problems (e.g., Anthenien, Lembo & Neighbors, 2016; Merrill & Read, 2010). A longitudinal study by Beseler, Aharonovich, Keyes and Hasin (2008) found that CopM at baseline predicted alcohol dependence 10 years later. Another longitudinal study over a 16 year period by Littlefield, Sher and Wood (2010) found that both EnH and CopM predicted concurrent and subsequent alcohol problems, as was also reported in a more recent, one-year longitudinal study by Mackinnon, Kehayes, Clark, Sherry and Stewart (2014). As Cooper (1994) proposed that the basis of internally motivated drinking behavior is the individual's personality, EnhM and CopM were the drinking motives of interest in the present study, which examined two distinct personality traits – alexithymia and reward sensitivity - in relation to drinking.

Gray's (1982) Reinforcement Sensitivity Theory (RST) posited that differences in approach and avoidance sensitivity are the fundamental building blocks of personality, and are governed by two neurologically based motivational systems, the Behavioral Activation System (BAS) and the Behavioral Inhibition System (BIS). The BAS is responsible for regulating an individual's response to appetitive stimuli, such that an individual with a strong BAS is more likely to engage in approach behaviour and experience positive emotions in situations that cue reward (Dawe & Loxton, 2004). Conversely, the BIS regulates an avoidance response to aversive stimuli, such that an individual with an overactive BIS is more likely to inhibit approach in situations which cue negative outcomes. The two motivational systems manifest as differences in sensitivity to reward (SR; BAS) and punishment (SP; BIS). Heightened SR has been consistently associated with increased levels

of risky or problematic drinking in a range of adolescent and adult samples (e.g., Lyvers et al., 2009; Staiger et al., 2007). According to Dawe et al. (2004), individual differences in SR influence drinking onset age and incentive salience of alcohol-related cues. A negative relationship between SR and the age at onset of regular drinking has been reported (e.g., Lyvers, Duff & Hasking, 2011). By contrast, an opposite, positive association between SP and age of onset of regular drinking has been reported (Kambouropoulos & Staiger, 2004; Lyvers et al., 2011), such that those high in SP appear to be more likely to refrain from or delay drinking, perhaps due to health-related concerns (Lyvers et al., 2012; Stewart & Devine, 2000; Stewart, Zvolensky & Eifert, 2002; Theakston et al., 2004). A scale commonly used to measure Gray's two fundamental trait dimensions is the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ; Torrubia, Avila, Moltó, & Caseras, 2001). Cogswell, Alloy, van Dulmen, and Fresco (2006) reported that the SPSRQ is not only more faithful to Gray's model than the original BIS/BAS scales, but also easier to interpret. The SPSRQ was thus used to index SR/BAS and SP/BIS in the present study.

Alexithymia has been consistently linked to the development of alcohol-related problems. In clinical samples, alexithymia has been related to more severe alcohol cravings, alcohol dependence and higher relapse rates (e.g., Loas, Fremaux, Otani, Lecercle & Delahousse, 1997; Thorberg et al., 2009, 2010, 2011). A community-based study by Lyvers, Lysychka, and Thorberg (2014) revealed that alexithymia was associated with anxiety, intrusive alcohol based thoughts, and heavier drinking. Only a few studies utilizing non-clinical samples (e.g., Bruce et al., 2012; Lyvers et al., 2012; Lyvers, Simons, Hayes & Thorberg, 2014) have investigated drinking motives in relation to alexithymia. Bruce et al. found positive relationships between Toronto Alexithymia Scale (TAS-20) scores and the internal drinking motive of CopM as well as the external drinking motive of ConM; there were weak (though still significant) relationships of alexithymia with the other two drinking

motives (EnhM and SocM) in a large (n = 862), predominantly female (76%) university sample. However, alexithymia scores were only weakly associated with drinking in their sample (r = .08). Bruce et al. reported at least partial mediation of the alexithymia-alcohol relationship by all four drinking motives, and concluded that the mediating role of CopM reflected attempts to use alcohol to cope with the negative emotions associated with alexithymia. Veilleux, Skinner, Reese and Shaver (2014) did not specifically measure alexithymia, but reported that a "lack of emotional clarity" mediated the relationship between negative affect and CopM in their university student sample. In a community sample, Lyvers et al. (2012) found that CopM mediated the relationship between one aspect of alexithymia - difficulty identifying feelings - and risky drinking, however both age and SP also influenced these relationships in a complex way, with a negative direct relationship of SP to risky drinking. Given the association of alexithymia with the aversive negative mood states of anxiety and depression, the relationship of alexithymia to CopM was predicted to be mediated by negative mood in the present study as hypothesized by Bruce et al. (2012).

The present study assessed SR, SP, negative mood and alexithymia in relation to internal drinking motives and risky drinking in a sample of social drinkers aged 18-45 years. Based on theoretical and empirical considerations described above, SR was expected to show a positive relationship to current levels of alcohol use that would be mediated by EnhM, and to show a negative relationship to drinking onset age as in previous research. The relationship of alexithymia to risky drinking was expected to be mediated by CopM, with an index of negative mood in turn mediating the association of alexithymia with CopM. In other words, higher SR was expected to be associated with drinking for positive reinforcement (to "get high," or EnhM), whereas higher alexithymia was expected to be associated with drinking for negative reinforcement (alleviation of negative moods, or CopM).

Method

Participants

The initial sample of 191 participants included university students and members of the local community with the goal of obtaining a broad sample of young Australian adults. Through exclusion criteria and removal of multivariate outliers, this was reduced to a sample of 155, comprised of 44 university students and 111 community members. Participants were excluded for answering 'no' to consuming alcohol, being below 18 or above 45 years of age, having suffered a traumatic brain injury, and/or having been diagnosed with any psychiatric or neurological illness. An additional 12 participants were removed as multivariate outliers. The final sample consisted of 80 females and 75 males aged 18-45 years (M = 21.95 years, SD = 6.19). All reported being consumers of alcoholic beverages (note that the legal drinking age in Australia is 18 years), and all rated their English language proficiency as high.

Materials

The questionnaires described below were administered online to all participants.

Demographics. Participants were asked to answer questions regarding their gender, age, country of origin, highest level of education, English proficiency, and age of onset of regular (i.e., weekly) drinking. As exclusion criteria, participants were also asked if they consumed alcohol at least occasionally, had ever suffered a traumatic brain injury (TBI), or had ever been diagnosed with any psychiatric or neurological illnesses; an answer of "no" to drinking alcohol, or a "yes" to either of the latter questions, led to removal of the corresponding case from the data set.

Depression Anxiety Stress Scales 21 (DASS-21; Lovibond & Lovibond, 1995a). The DASS-21 is a 21-item self-report measure designed to assess negative mood via three subscales: depression (DASS-D), anxiety (DASS-A) and stress (DASS-S). The measure follows a four-point Likert scale that asks individuals to rate the extent a statement applied to

them over the past week, from 0 (*did not apply to me at all*) to 3 (*applied to me very much, or most of the time*). The DASS-A subscale assesses anxious states through questions such as "I felt scared without any good reason," whereas the DASS-D subscale evaluates dysphoric mood states via items such as "I felt that I had nothing to look forward to." The DASS-S subscale was developed to assess features common to both anxiety and depression, and includes questions targeted to evaluate such symptoms as tension and irritability, e.g., "I found it hard to wind down." The DASS-21 consists of a subset of questions from the originally developed 42-item scale. The seven items comprising each subscale are summed and doubled to be equivalent to the original version, with higher scores reflecting more negative mood. Evidence of high internal consistency was provided in the present study, with Cronbach's alphas of .85 calculated for DASS-D, .79 for DASS-A and .87 for DASS-S. Total DASS-21 scores were used to index negative mood in the present study, and yielded a Cronbach's alpha of .90.

Toronto Alexithymia Scale (TAS-20; Bagby, Parker, & Taylor, 1994). The TAS-20 is a 20-item empirically derived scale used to assess alexithymia in both research and clinical practice. Respondents are asked to indicate how much they agree with a list of statements on a five-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The scale is comprised of three subscales: difficulty identifying feelings (DIF), difficulty describing feeling (DDF) and externally oriented thinking (EOT). Scores can be calculated for each of these subscales as well as a total alexithymia score; the present study used total scores to index alexithymia. The DIF subscale consists of seven items used to assess difficulty in identifying feelings, such as "I don't know what's going on inside me." The DDF subscale consists of five questions that assess difficulty in describing feelings, including "people tell me to describe my feelings more." The EOT subscale is comprised of eight items that assess concrete thinking via items such as "I prefer to analyze problems rather than just describe

them" (reverse scored item). After reverse scoring five items, scores are calculated by summing relevant items together. A total score on the TAS-20 can range from 20 to 100 with higher scores reflecting higher alexithymia. Internal consistency calculated in the current study yielded a Cronbach's alpha reliability coefficient of .81 for the total score, which was the score of interest for present purposes.

Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ; Torrubia et al., 2001). The SPSRQ is a self-report measure developed to assess the motivational systems of the BAS and BIS proposed by Gray's (1982) RST. The 48-item yes-no formatted instrument is comprised of two scales, SR and SP, of 24 items each, which represent the BAS and the BIS respectively. A response of yes is assigned a value of 1, and no a value of 0. "Do you sometimes do things for quick gains?" is a sample question on SR. A total score for SR is calculated by summing all of the even numbered items together. A total score for SP is determined by summing all odd numbered items together, which include questions such as "Are you often afraid of new or unexpected situations?" Higher scores on each scale are indicative of a stronger motivational system (Torrubia et al., 2001). In the present study, internal consistencies yielded Cronbach's alphas of .77 for SR and .84 for SP.

Drinking Motives Questionnaire-Revised (DMQ-R; Cooper, 1994). This self-report measure assesses an individual's relative frequency of drinking due to four conceptually and empirically distinct motivational dimensions: EnhM, SocM, CopM, and ConM. The instrument consists of 20 questions, with five questions dedicated to each dimension. The scale instructs individuals to consider all of the times they have consumed alcohol, and to then indicate, on a six-point Likert scale ranging from 1 (*never*) to 6 (*almost always*), how often they have drank for each given motive. "How often do you drink to get high?" is an example of drinking for enhancement purposes (EnhM), "how often do you drink because it improves parties and celebrations?" is an example of a drinking for social reasons (SocM),

"how often do you drink to forget about your problems?" is an example of drinking to cope (CopM), and "how often do you drink to be liked?" is an example of drinking to conform (ConM). Scores for each subscale are calculated by summing related items together and dividing by 5, with higher mean scores signifying greater factor endorsement independent of alcohol consumption frequency (Stewart et al., 2002). Evidence of good internal consistency was obtained in the present study, with Cronbach alphas of .85, .92, .87, and .91 for EnhM, SocM, CopM, and the ConM subscales respectively. The measures of internal drinking motives EnhM and CopM were the scores of interest in the present study.

Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, De la Fuente & Grant, 1993). The AUDIT is a 10-item measure used to screen for risky or problematic drinking, and incorporates the three domains of alcohol consumption, alcohol-related problems and alcohol dependence. Items 1-8 are scored on a five-point Likert scale, each with different anchors. The final two questions are scored on a three-point Likert scale from 0 (*no*) to 4 (*yes, during the last year*). The first three questions measure alcohol consumption, for example, "how often do you have a drink containing alcohol?" Items 4-6 assess alcohol dependence and include the question, "how often during the last year have you failed to do what was normally expected of you because of drinking?" The final four questions assess alcohol-related problems, e.g., "have you or someone else been injured because of your drinking?" Total scores are calculated by summing all items together and can range from 0 to 40. Scores between 0 and 7 reflect low risk drinking, whereas scores of 8-15 indicate hazardous drinking, and scores of 16 and above indicate harmful drinking. The Cronbach's alpha coefficient calculated for the AUDIT in the present study was .82.

Procedure

Approval was obtained from the university ethics committee prior to data collection. Participants were recruited in two ways: via the undergraduate psychology research

participation pool (university students) and via advertisements in a local newspaper (community participants). As an incentive to participate, the university students were offered one credit point towards an undergraduate psychology subject, whereas community participants were offered a $40 shopping gift voucher. Each recruitment method instructed interested individuals to email the researchers for a link to the online questionnaire battery. Data collection was administered using the online platform Survey Monkey. To reduce response bias, scale titles were removed, such that the only prompt provided at the top of each page was how to respond. The first page of the questionnaire battery was an explanatory statement that indicated each participant's right to withdraw at any time; that their responses were anonymous; and that provided the researchers' and ethics committee's contact details in case of concerns. The explanatory statement also stated that by clicking on "next," individuals were consenting to participate. The complete battery took participants less than one hour to complete. To receive the incentive, participants were asked to send proof of completion to the researchers in the form of a screenshot of the final page of the battery.

Results

Analyses were conducted using SPSS Statistics 21. Data for 24 participants were removed in accordance with the exclusion criteria. An additional 12 participants were removed as multivariate outliers, bringing the final sample to $N = 155$ as described earlier.

Preliminary Analyses

Means and standard deviations for all measures are shown in Table 1. Based on the AUDIT scoring criteria described earlier, the present young Australian adult sample was characterized by hazardous drinking. There were no differences between subsamples (university students vs. community participants) on any variable (including demographics) except AUDIT, which indicated riskier alcohol use by students ($M = 16.50$, $SD = 6.84$) compared to community participants ($M = 13.80$, $SD = 5.09$), $p = .01$.

Table 1 shows the intercorrelations of the continuous measures. Significant positive relationships of SR with both EnhM and the AUDIT index of risky drinking were found, as expected. Also as predicted were the significant negative associations of age of onset of weekly drinking with SR, EnhM and AUDIT, such that higher scores on reward sensitivity, drinking to "get high," and current risky drinking were associated with drinking alcohol regularly at a younger age. By contrast SP was not correlated with drinking indices but was significantly positively correlated with all three negative mood indices of the DASS-21 and with TAS-20 scores as in previous work. Both EnhM and CopM were highly positively correlated with AUDIT scores, and CopM was moderately positively correlated with all three DASS-21 scales and with the TAS-20 as predicted; by contrast EnhM was not correlated with TAS-20 nor with any of the DASS-21 negative mood scales. The significant positive correlation of TAS-20 with AUDIT was as expected, as were the positive correlations of TAS-20 with all three negative mood indices of the DASS-21. Finally, two of the three negative mood indices of the DASS-21, the DASS-A index of anxiety and the DASS-D index of depression, were significantly positively correlated with AUDIT scores.

As shown in Table 1, age was significantly correlated with SR, EnhM and AUDIT. A one-way multivariate analysis of variance (MANOVA) was also performed to test for gender differences on any of the variables. AUDIT, SP, DASS-S and age at onset of weekly drinking showed anticipated gender differences, $F(10, 140) = 3.63$, $p < .001$, with men reporting significantly earlier drinking onset age and showing significantly higher AUDIT scores than women, whereas women scored significantly higher on SP and DASS-S than men. Inclusion of age and gender as covariates did not materially change the findings of the regression analyses reported below; hence for ease of interpretation, these regressions are reported without inclusion of covariates.

Regression Analyses

Regression analyses were undertaken to test for the predicted mediations. In the first of these models, TAS-20 alexithymia score was the predictor, drinking to cope (CopM) was the mediator, and the AUDIT index of risky drinking was the criterion. In the second model, TAS-20 was the predictor, the negative mood index of total DASS-21 (DASS-D + DASS-A + DASS-S) served as the mediator, and CopM was the criterion. In the third model the negative mood index was the predictor, CopM was the mediator and AUDIT the criterion. The final model examined whether drinking for positive reward (EnhM) mediated the relationship between the reward sensitivity index SR and AUDIT scores, with SR as the predictor, EnhM the mediator and AUDIT the criterion.

To support mediation, the Steps Approach proposed by Baron and Kenny (1986) was employed. First, the predictor variable was confirmed to be related to the criterion variable (see Table 1). A simple regression analysis was then performed to demonstrate an association between the predictor and proposed mediator. Thirdly, a hierarchical multiple regression examined whether the proposed mediator accounted for variance in the criterion over and above that accounted for by the predictor. For the hierarchical regression, at Step 1 the predictor was entered into the equation, followed by the mediator at Step 2. Finally, a Sobel test (Sobel, 1982) was performed using Preacher and Leonardelli's online Sobel Calculator (http://quantpsy.org/sobel/sobel.htm).

Alexithymia and Risky Drinking. Table 2 shows the results of analyses conducted to examine mediation, whereas Figure 1 depicts the mediated models of the relationships between alexithymia, negative mood, drinking to cope and risky drinking.

***Predicting risky drinking from alexithymia and coping motives*.** A simple regression revealed TAS-20 to significantly predict CopM, $F(1, 153) = 19.53$, $p < .001$. The model explained 11 percent of the variance in CopM. The standardized regression coefficient was

significant with a 1 *SD* increase in the TAS-20 resulting in a .34 *SD* increase in CopM. TAS-20 and CopM were then regressed on AUDIT. At Step 1, TAS-20 explained significant variance in the AUDIT index of risky alcohol consumption, $F_{change}(1, 153) = 11.74$, $p = .001$. The additional variance explained by CopM at Step 2 was significant, $F_{change}(1, 152) = 25.30$, $p < .001$. The full model was significant accounting for 20 percent of the variance in AUDIT, $F(2, 152) = 19.45$, $p < .001$. CopM was found to significantly predict risky alcohol consumption, with a 1 *SD* increase in CopM resulting in a .39 *SD* increase in AUDIT. Alexithymia did not remain a significant predictor of AUDIT at Step 2 (see left panel in Table 2). The Sobel test was significant, indicating that coping motives for drinking fully mediated the relationship between alexithymia and risky alcohol consumption, $z = 3.32$, $p = .001$.

Predicting coping motives from alexithymia and negative mood. TAS-20 alexithymia scores significantly predicted the negative mood index of total DASS-21 scores and accounted for 13 percent of the variance, $F(1, 153) = 23.25$, $p < .001$. The standardized regression coefficient for alexithymia was significant such that a 1 *SD* increase in the TAS-20 resulted in a .36 *SD* increase in DASS-21.

At Step 1 of the hierarchical regression, TAS-20 accounted for significant variance in CopM, $F_{change}(1, 153) = 19.53$, $p < .001$. At its level of entry, alexithymia scores significantly predicted CopM, with a 1 *SD* increase in the TAS-20 resulting in a .34 *SD* increase in CopM. After entering the negative mood index at Step 2, the model remained significant, $F(2, 152) = 15.90$, $p < .001$. The additional variance in CopM explained by the total DASS-21 negative mood index at Step 2 was significant, $F_{change}(1, 152) = 11.00$, $p = .001$. Specifically, the mediator explained 6 percent of the total 17 percent of variance in CopM scores. Alexithymia remained a significant predictor of CopM at Step 2, $p = .003$ (see right panel in Table 2). Sobel Test was significant, $z = 2.73$, $p = .006$, indicating that the

DASS-21 negative mood index partially mediated the relationship between TAS-20 alexithymia scores and the CopM index of drinking to cope.

Predicting risky drinking from negative mood and coping motives. The negative mood index total DASS-21 significantly predicted coping motives for drinking (CopM) accounting for 12 percent of the variance, $F(1, 153) = 21.37$, $p < .001$. The standardized regression coefficient for total DASS-21 was significant such that a 1 SD increase in total DASS-21 resulted in a .35 SD increase in CopM.

At Step 1, total DASS-21 accounted for significant variance in AUDIT, F_{change} (1, 153) = 4.33, $p = .04$. At its level of entry, DASS-21 significantly predicted AUDIT, with a 1 SD increase in DASS-21 resulting in a .17 SD increase in AUDIT. After entering CopM at Step 2, the model was also significant, $F(2, 152) = 17.53$, $p < .001$. The additional variance in AUDIT explained by CopM at Step 2 was significant, F_{change} (1, 152) = 29.91, $p < .001$. Specifically, the mediator explained 16 percent of the total 19 percent of variance in AUDIT scores. The negative mood index DASS-21 was no longer significant at Step 2 (see Table 3). Sobel Test was significant, $z = 3.53$, $p < .001$, indicating that coping motives fully mediated the association between negative mood and risky drinking.

Reward sensitivity and risky drinking. A simple regression revealed that SR significantly predicted the proposed mediator EnhM, $F(1, 153) = 31.04$, $p < .001$. SR explained 17 percent of the variance in the mediator. The standardized regression coefficient for SR was significant, such that a 1 *SD* increase in SR resulted in a .41 *SD* increase in EnhM.

A hierarchical regression was then performed. As shown in Table 4, the model was significant at Step 1, $F_{change}(1, 153) = 31.62$, $p < .001$. The predictor variable SR accounted for 17 percent of the variance in risky alcohol consumption as indexed by AUDIT. A significant 18 percent of additional variance in risky drinking was explained at Step 2 by

EnhM, $F_{change}(1, 152) = 41.71$, $p < .001$. The final model was significant, $F(2, 152) = 40.87$, $p < .001$, and together the variables explained 35 percent of the variance in risky alcohol consumption. As outlined in Figure 2, at Step 2, with the variance explained by EnhM controlled for, the path from the predictor variable SR to the criterion variable AUDIT was reduced but was still significantly different from zero. The Sobel Test was significant, indicating that EnhM partially mediated the relationship between SR and AUDIT, $z = 4.22$, $p < 001$.

Discussion

The associations of reward sensitivity and alexithymia with risky or problematic drinking have been amply supported in previous research (e.g., Dawe et al., 2004; Lyvers et al., 2014; Thorberg et al., 2009). The present study examined the hypothesis that such relationships between personality traits and drinking are mediated by the proximal variables of internal drinking motives (Cooper, 1994; MacKinnon et al., 2014). Specifically, the present study proposed that the association of reward sensitivity with risky drinking is mediated by the internal motive of drinking for positive reward, i.e., drinking to "get high," whereas the association of alexithymia with risky drinking is mediated by the internal motive of drinking to cope, i.e., drinking to suppress or alleviate negative mood states such as anxiety and depression. Both hypotheses were supported by the present findings. The association of the reward sensitivity index SR with the risky drinking index AUDIT was found to be partially mediated by internal enhancement drinking motives (EnhM). The association of the alexithymia index TAS-20 with AUDIT was found to be fully mediated by the internal motives of drinking to cope (CopM), such that the association of alexithymia and the latter was partially mediated by negative mood (as indexed by DASS-21), and the association of negative mood with AUDIT was fully mediated by CopM. Figures 1 and 2 illustrate these relationships.

Although the present study utilized a non-clinical sample, the findings are congruent with Cloninger's (1987; Cloninger et al., 1996) categorization of alcoholism into Types I and II, which was based in part on different primary drinking motives. Given the high (typically 50% or more) prevalence of alexithymia in alcohol-dependent clinical samples and the strong associations of alexithymia with negative mood states such as anxiety and depression (see Thorberg et al., 2009, for a review), alexithymic clients undergoing treatment for alcohol use disorder would appear to align with Cloninger's Type I alcoholism concept. On the other hand, strong positive relationships between SR, EnhM and the risky drinking index AUDIT were evident in the present sample, with EnhM partially mediating the association between SR and AUDIT; EnhM was unrelated to alexithymia or negative mood. These relationships, though found in a non-clinical sample, would seem to align with Cloninger's Type II alcoholism concept. The obtained relationships of both SR and EnhM to early drinking onset age were also consistent with the Type II concept in the present study. Type I alcoholism is said to have a late onset, whereas Type II is said to be characterized by an early onset age; the present study found significant negative relationships of both SR and EnhM with age at onset of weekly drinking, which is consistent with Cloninger's Type II. By contrast neither TAS-20 alexithymia nor CopM were correlated with drinking onset age in the present sample. Taken together these data suggest there were two distinct groups of risky drinkers in the sample – those with high levels of alexithymia who are likely to drink to cope with negative mood, and those with high levels of reward sensitivity who are likely to drink to "get high."

Previous work has indicated that drinking for internal or mood change motivations – i.e., CopM and EnhM – is associated with a heightened risk of developing alcohol-related problems (Anthenien et al., 2016; Beseler et al., 2008; Merrill & Read, 2010; Stewart & Devine, 2000). The present findings suggest that the primary internal drinking motives distinguishing Cloninger's Type I and Type II alcoholism are paralleled by the well-known

associations of two distinct personality traits, alexithymia and SR, with riskier drinking in the general population – as mediated, according to the present findings, by internal coping motives for alexithymia and internal enhancement motives for SR. Longitudinal research (Beseler et al., 2008; Littlefield et al., 2010; Mackinnon et al., 2014) has supported the ability of CopM and EnhM at baseline to predict future alcohol-related problems, with CopM predicting future alcohol dependence in the Beseler et al. study. The present findings suggest two distinct developmental trajectories from inherent personality traits to problematic drinking. The data were thus in line with Cloninger's typology, and in some respects parallel the findings of longitudinal research by Littlefield et al. (2010) that personality traits of neuroticism and rash impulsiveness were differentially related to CopM and EnhM and to changes in drinking over time, though the SR dimension of impulsivity was not measured in their study.

Limitations of the present study include the cross-sectional sample and the use of anonymous online recruitment and testing, which led to 19% of the original sample being discarded due to failure to meet inclusion criteria or unusual response patterns. Nevertheless in the final sample the Cronbach's alpha reliability indices were good to excellent for all measures, and there were no major deviations from normality. One caveat regarding the present study is that, given the nature of the young adult sample and the sample size (n = 155), the findings should not be interpreted as indicating that CopM are the only type of drinking motive accounting for the relationship between alexithymia and alcohol consumption. In a much larger, predominantly female university student sample, Bruce et al. (2012) reported mediations by the other three drinking motives as well, though none of those associations with alexithymia were nearly as strong as the relationship with CopM, and alexithymia was only weakly related to drinking overall. The present study examined only internal drinking motives based on evidence that CopM and EnhM are specifically associated

with an elevated risk of alcohol-related problems (Cooper, 1994; Stewart & Devine, 2000; Mackinnon et al., 2014). In the present sample, CopM but not EnhM were associated with alexithymia and negative mood, consistent with two distinct patterns of personality and drinking motives in relation to risky drinking. Regarding drinking levels, heavier drinking was associated with stronger endorsement of drinking motives in the present study, though interestingly this was not the case for EnhM in a previous study using an older sample (Lyvers et al., 2012).

The findings reported here may have clinical implications with regards to the assessment, prevention and treatment of risky drinking that may over time progress to alcohol use disorder. Although previous research in alcohol-dependent outpatients found that those with high levels of alexithymia expected alcohol to intensify negative emotions (Thorberg et al., 2016b), in the current non-clinical sample those with higher alexithymia reported drinking to cope with negative emotions in line with motivational models of alcohol use (Cox & Klinger, 1988) and the self-medication hypothesis (Khantzian, 1985). Coping motives would thus appear to be an appropriate treatment target in interventions for alcohol use disorder in those with alexithymia, whereas enhancement motives would be a more appropriate treatment target for alcohol use disorder in those characterized by high reward sensitivity and associated disinhibited behavior (Lyvers et al., 2009). Similar conclusions were recently made by Studer, Baggio, Dupuis, and Gmel (2016) based on their findings in a Swiss sample. Internal drinking motives thus merit further investigation in concert with Cloninger's (1987) psychobiological model of personality, as well as alexithymia and sensitivity to reward and punishment, in order to achieve a more comprehensive understanding of the etiology of risky or problematic alcohol use.

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Table 1

Summary of Means, Standard Deviations and Intercorrelations of Study Variables (N=155)

Variable	M (*SD*)	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
1. SR	12.50 (*4.43*)	-											
2. SP	11.91 (*5.24*)	.07	-										
3. EnhM	3.90 (*1.10*)	.41***	.07	-									
4. CopM	2.43 (*1.12*)	.41***	.22**	.36***	-								
5. DASS-D	9.06 (*8.01*)	.18*	.37***	.07	.29***	-							
6. DASS-A	6.22 (*6.54*)	.26**	.36***	.03	.32***	.66***	-						
7. DASS-S	11.41 (*8.43*)	.20*	.30***	.01	.32***	.67***	.70***	-					
8. DASS-21	26.68 (*20.37*)	.24**	.38***	.04	.35***	.88***	.87***	.90***	-				
9. TAS-20	47.21 (*10.16*)	.18*	.44***	.12	.34***	.38***	.28**	.30***	.36***	-			
10. AUDIT	14.34 (*5.90*)	.41***	.04	.56***	.43***	.19*	.20*	.07	.17*	.27**	-		
11. AOD	17.76 (*1.73*)	-.27**	.04	-.22**	-.04	.08	.01	.05	.05	-.13	-.36***	-	
12. Age	21.95 (*6.19*)	-.27**	-.10	-.30***	.10	.10	-.06	.19*	.10	-.01	-.30***	.27**	-

Note. SR = sensitivity to reward; SP = sensitivity to punishment; EnhM = enhancement motives; CopM = coping motives; DASS-D = Depression Anxiety Stress Scales depression subscale; DASS-A = Depression Anxiety Stress Scales anxiety subscale; DASS-S = Depression Anxiety Stress Scales stress subscale; DASS-21 = Depression Anxiety Stress Scales total score; TAS-20 = Toronto Alexithymia Scale total score; AUDIT = Alcohol Use Disorders Identification Test; AOD = age of onset of weekly drinking.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 2

Hierarchical Multiple Regression Analyses to Assess the Relationships between Alexithymia, Drinking to Cope, Mood and Risky Drinking

Predicting Risky Drinking from Alexithymia and CopM						Predicting CopM from Alexithymia and Negative Mood					
Predictor	ΔR^2	β	*B*	*SE B*	95% CI for *B*	Predictor	ΔR^2	β	*B*	*SE B*	95% CI for *B*
Step 1	.07**					Step 1	.11***				
Constant			7.01	2.19	[2.70, 11.33]	Constant			3.38	2.03	[-0.64, 7.39]
TAS-20		.27**	0.16	0.05	[0.07, 0.25]	TAS-20		.34***	0.19	0.04	[0.10, 0.27]
Step 2	.13***					Step 2	.06**				
Constant			5.64	2.05	[1.59, 9.69]	Constant			3.93	1.98	[0.03, 7.84]
TAS-20		.14	0.08	0.05	[-0.01, 0.17]	TAS-20		.24**	0.13	0.04	[0.05, 0.22]
CopM		.39***	0.41	0.08	[.25, 0.57]	DASS-21		.26**	0.07	0.02	[0.03, 0.12]

Note. SE B = standard error of unstandardised coefficient; CI = confidence interval; CopM = total score on drinking to cope; TAS-20 = Toronto Alexithymia Scale total score; DASS-21 = Depression Anxiety Stress Scales total score.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 3

Hierarchical Multiple Regression Analysis Predicting Risky Drinking from Negative Mood and Coping Motives

Predictor	ΔR^2	β	*B*	*SE B*	95% CI for *B*
Step 1	.03*				
Constant			13.05	0.77	[11.52, 14.58]
DASS-21		.17*	0.05	0.02	[0.00, 0.09]
Step 2	.16***				
Constant			8.75	1.06	[6.66, 10.85]
DASS-21		.02	0.01	0.02	[-0.04, 0.05]
CopM		.43***	0.45	0.08	[0.29, 0.61]

Note. SE B = standard error of unstandardised coefficient; CI = confidence interval; DASS-21 = Depression Anxiety Stress Scales total score; CopM = coping motives.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4

Hierarchical Multiple Regression Analysis Predicting Risky Drinking from Sensitivity to Reward and Enhancement Motives

Predictor	ΔR^2	β	*B*	*SE B*	95% CI for *B*
Step 1	.17***				
Constant			7.45	1.30	[4.88, 10.01]
SR		.41***	0.55	0.10	[0.36, 0.75]
Step 2	.18***				
Constant			0.75	1.55	[-2.31, 3.82]
SR		.22**	0.30	0.10	[0.11, 0.49]
EnhM		.46***	0.51	0.08	[0.35, 0.66]

Note. SE B = standard error of unstandardised coefficient; CI = confidence interval; SR = sensitivity to reward; EnhM = enhancement motives.
* $p < .05$. ** $p < .01$. *** $p < .001$.