



# Deter the emotions: Alexithymia, impulsivity and their relationship to binge drinking

Aleksandra M. Herman<sup>a,b,\*</sup>, Nathalia Pilcher<sup>b</sup>, Theodora Duka<sup>b,c</sup>

<sup>a</sup> Department of Psychology, Royal Holloway, University of London, Egham, UK

<sup>b</sup> School of Psychology, University of Sussex, Falmer, UK

<sup>c</sup> Sussex Addiction Research and Intervention Centre, University of Sussex, Falmer, UK

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## ABSTRACT

**Introduction:** The relevance of both emotion processing and impulsivity to alcohol use and misuse is increasingly recognised, yet there is a scarcity of studies addressing their reciprocal interaction. The present study aimed to examine the role that difficulties in emotion processing and trait impulsivity play in explaining binge drinking pattern of alcohol use in student population. We looked at binge drinking, as it is a risk factor to later alcohol abuse and is a common alcohol drinking habit among students. Alexithymia (from Greek as “deter/repel emotions”), a difficulty in identifying and describing feelings in self and others is increasingly recognised as a feature of alcohol misuse.

**Methods:** One-hundred and seventy-four student alcohol drinkers were assessed for their drinking habits (Alcohol Use Questionnaire), as well as for alexithymia (Toronto Alexithymia Scale) and impulsivity trait (Barratt Impulsiveness Scale); facial emotional expression judgements were also tested.

**Results:** A direct relationships between, both, alexithymia and impulsivity, and binge drinking was found. When combined, trait impulsivity partially mediated the relationship between alexithymia and binge drinking. Facial emotional expression judgements also showed a relationship with binge drinking.

**Conclusions:** These findings highlight the importance of both emotion processing and impulsivity in understanding binge drinking and indicate potential routes for prevention and intervention techniques, especially towards those who may be at risk of later alcohol abuse.

## 1. Introduction

There is substantial evidence regarding the contribution of emotion dysregulation and impulsivity to alcohol use and dependence independently from each other (Townshend & Duka, 2003; Dick, Smith, & Olausson, 2010; Berking et al., 2011; Sanchez-Roige, Baro, & Trick, 2014; Caswell, Celio, Morgan, & Duka, 2016; also see Herman & Duka, 2019 for review). Emotion deficits contribute to both the development and maintenance of alcohol use (e.g. Kober, 2014; Kopera, Jakubczyk, & Suszek, 2015). Past studies have found that alcohol abuse is linked to deficits in recognition and changes in perception of emotional facial expressions (Kornreich et al., 2001a, 2001b; Philippot, Kornreich, & Blairy, 2006; Townshend & Duka, 2003). For example, Townshend and Duka (2003) showed that alcoholics present *enhanced* fear recognition in several facial emotional expressions, which has been linked to the number of previous detoxifications and suggests alterations in amygdala

functioning. Additionally, several studies have reported that Alcohol Use Disorder (AUD) patients both recently and long-term detoxified, showed overestimation of facial emotion expressions estimates (Kornreich et al., 2001a, 2001b; Philippot et al., 2006). However, the findings regarding emotion processing in binge drinking are mixed. While some studies indicate poorer emotional recognition (both visual and auditory) in binge drinkers compared to controls, particularly for fear and sadness (Lannoy et al., 2018b, 2019; Maurage, Bestelmeyer, & Rouger, 2013), other demonstrate an absence of emotional deficits at the behavioural level in binge drinkers (Huang, Holcomb, Cruz, & Marinkovic, 2018; Lannoy et al., 2017, 2018a). Yet, altered cerebral processing of emotional stimuli in binge drinkers is regularly reported even in the absence of overt behavioural changes (Huang et al., 2018; Lannoy, D'Hondt, & Dormal, 2018a; Maurage et al., 2013). Together, these results disclose that alcohol misuse and binge drinking may be linked to altered processing of emotional expressions, particularly in the negative

\* Corresponding author at: Department of Psychology, Royal Holloway, University of London, Egham, UK.

E-mail address: [aleksandra.herman@rhul.ac.uk](mailto:aleksandra.herman@rhul.ac.uk) (A.M. Herman).

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domain, but enhanced emotion intensity ratings, which might be particularly strong in the domain of fear in alcohol abuse.

In terms of emotion processing, alexithymia is also increasingly recognised as an important aspect of alcohol misuse. Alexithymia is a multifaceted construct first described by Sifneos (1973) as having difficulties in identifying and describing feelings, problems distinguishing between feelings and bodily sensations of emotional arousal, and an externally orientated style of thinking. Individuals high in alexithymia find it difficult to make sense of their own and other's emotions, resulting in a tendency to focus on external, rather than internal, causes of behaviour (Bibby, 2016). Alexithymia is a stable trait (Tolmunen, Heliste, & Lehto, 2011) and its prevalence in the general population has been estimated at 13%, with the rates reaching up to 78% among alcohol-abusing individuals (Cruise & Becerra, 2018; Rybakowski, Ziolkowski, Zasadzka, & Brzeziński, 1988; Thorberg, Young, Sullivan, & Lyvers, 2009).

Interestingly, binge drinking (BD), the pattern of alcohol use whereby periods of heavy drinking until intoxication are intermitted with the periods of abstinence (Courtney & Polich, 2009; Townshend & Duka, 2002), is more common among individuals with higher levels of alexithymia (Thorberg et al., 2009). This may be because alexithymic individuals believe consuming alcohol will improve their social functioning (Thorberg, Young, & Lyvers, 2016). Individuals with alexithymia are often uncomfortable in social settings (Uzun, Ates, Cansever, & Ozsahin, 2003) and use alcohol to help them to access emotions not otherwise shown and thus to cope better in these circumstances (Thorberg et al., 2016). Indeed, alexithymic individuals have specific expectancies regarding alcohol, for example believing that alcohol makes them outgoing, friendly, and confident (Thorberg et al., 2016). Additionally, high alexithymia scores predict earlier age of alcohol use onset, longer duration of alcohol misuse, and increased amount of alcohol consumed (Kopera et al., 2015). Correspondingly, high alexithymia scores, together with impulsivity, predict heavy alcohol drinking among university students (Betka et al., 2019; Lyvers, Narayanan, & Thorberg, 2019). Thus, alexithymia may specifically increase the risk of developing AUD (Cruise & Becerra, 2018; Uzun et al., 2003).

As many young people perceive BD as an acceptable way to bond with peers, they often intend to get intoxicated as quickly as possible (Barth, 2015). This dangerous style of alcohol consumption in students is a major concern as it has been associated with many harmful consequences including blackouts (Burns et al., 2016) or risky behaviours such as drink driving and unprotected or unplanned sexual behaviours (Martinez, Sher, & Wood, 2014; Townshend, Kambouropoulos, & Griffin, 2014). Importantly, BD is associated with cognitive and behavioural deficits (Scaife & Duka, 2009), with trait and behavioural impulsivity found to contribute to both the initiation and maintenance of alcohol consumption (Crews & Boettiger, 2009; Herman & Duka, 2019; Sanchez-Roige et al., 2014, 2016). Both trait and state increases in impulsivity may elevate the tendency to consume alcohol (Caswell et al., 2016; de Wit, 2009). It has been suggested that alcohol consumption is maintained due to neural changes caused by the repeated alcohol use that lead to further cognitive and emotional dysfunctions (Crews & Boettiger, 2009; Stephens & Duka, 2008; Townshend & Duka, 2005) and exacerbates impulsivity (Stautz & Cooper, 2013; for a recent review see Herman & Duka, 2019).

Emotions, impulsivity and alcohol use are intimately linked (for review see Herman & Duka, 2019). By providing feedback and stimulating retrospective appraisal of actions, emotions help to guide, control, and regulate our behaviours to satisfy current situational and contextual demands (Baumeister, Vohs, Nathan DeWall, & Liqing Zhang, 2007). When access to such information is restricted (as in elevated alexithymia levels), uncontrolled, dysregulated emotional and behavioural responses, such as alcohol use, become more likely, especially in emotionally provocative situations (Coriale et al., 2012; Edwards & Wupperman, 2017; Fox, Hong, & Sinha, 2008; Kopera et al., 2015; Scarpazza, Sellitto, & di Pellegrino, 2017; van Strien & Ouwens, 2007).

Moreover, difficulties in emotion processing are positively related to self-report measures of impulsivity (Schreiber, Grant, & Odlaug, 2012). At a neural level, areas of the brain involved in emotion experiencing and processing overlap with parts of the brain involved in impulsive behaviours (Herman, Critchley, & Duka, 2018b; Phan, Wager, Taylor, & Liberzon, 2002). These regions include the orbitofrontal cortex, amygdala, anterior cingulate cortex and basal ganglia, suggesting that dysfunction in those areas may result in an impairment in emotion processing and impulsivity (Schreiber et al., 2012; for a review see Herman & Duka, 2019). Thus, as alexithymic individuals have difficulties in identifying emotional states in self and others, they may use impulsive actions, such as bingeing on alcohol, to cope with the (difficult for them to name or recognise) emotional arousal.

Yet, despite the individual contribution of alexithymia and impulsivity to alcohol use and abuse, as well as the relationship between emotions processing and impulsive behaviours, there is a lack of studies looking at these two aspects simultaneously for their contribution to alcohol use. In one notable exception, emotion dysregulation and impulsivity showed significant association with alcohol misuse in a mixed psychiatric sample as well as in a community-sample (Garofalo & Velotti, 2015). Moreover, emotion dysregulation exerted an indirect effect on alcohol misuse, through the effect of trait impulsivity (Garofalo & Velotti, 2015). Negative urgency, defined as a self-reported tendency to act on impulse when experiencing strong, negative emotions, also mediated the relationship between alexithymia and alcohol-related problems, whereas positive urgency mediated the relationship between alexithymia and alcohol consumption (Shishido, Gaher, & Simons, 2013). Thus, alexithymia and difficulties in emotional regulation exert an indirect effect on alcohol use through impulsive tendencies. However, to our knowledge, the role of alexithymic features together with impulsivity in prediction of binge drinking is still to be investigated.

In summary, the role of emotional processing and impulsivity is well-acknowledged as contributors to alcohol use and misuse; however, their joint involvement remains understudied. Thus, in this study, we sought to examine whether alexithymia and trait impulsivity may play a combined role in explaining the binge drinking pattern of alcohol use in a sample of university students. In particular, we hypothesised that bingeing on alcohol may represent a maladaptive way to deal with ambiguous emotional states in self and difficulties recognising emotions in others while in social situations, which may be at least partially explained by the propensity to behave impulsively. Thus, we aimed at testing the indirect effect of alexithymia on alcohol binge drinking through impulsivity. Further analyses also looked into the relationship between emotion judgements using facial emotional expression recognition and BD severity. As past findings regarding emotional processing in alcohol binge drinkers are mixed, but there are more consistent reports of altered emotional expression recognition and sensitivity in alcoholic patients, we hypothesised that higher-binge drinking may be associated with a subtle bias in rating ambiguous facial expressions.

## 2. Method

### 2.1. Participants

Volunteers were recruited from The University Student Database, via social media announcements and via posters displayed around the campus. We recruited individuals who were aged between 18 and 40 years old, only current students who drink alcohol. Data is anonymous, confidential and handled following the General Data Protection Regulation (GDPR). Participation was encouraged with the chance to win a £25 prize. All procedures were approved by the local ethics committee.

### 2.2. Procedure

Data were collected online via Qualtrics platform (<https://www.qualtrics.com>)

trics.com). All volunteers provided informed consent before completing the survey.

### 2.3. Measures

*Sociodemographic Information Questionnaire* assessed age, sex, current level of study (undergraduate/postgraduate) and whether they consumed alcohol or not.

*Visual Analogue Scale of emotional perception (VASem)* was inspired by the valence-biased task (Davis, Neta, Kim, Moran, & Whalen, 2016; Kim, Somerville, & Johnstone, 2003; Neta, Davis, & Whalen, 2011; Petro, Tong, Henley, & Neta, 2018). Eight emotional facial expressions of surprise, half male, half female, were adopted from the NimStim database (Tottenham, Tanaka, & Leon, 2009). Only the expressions of surprise were selected as surprise is an ambiguous emotion associated with both happiness and fear (e.g., Kim et al., 2003): One can be surprised to receive an unexpected gift or to hear that one's loved one committed a crime. Participants rated to what extent the faces expressed happiness or fear on a 100-point VAS displayed below the image. We selected this scale based on Ekman and Friesen (1976) norms, which ordered six basic emotional facial expressions by their maximum potential to be confused (i.e., placing those most likely to be confused with each other side-by-side, resulting in happiness-surprise-fear-sadness-disgust-anger). Expressions were presented one at a time. Participants had unlimited time to rate each expression. The average rating of facial expressions served as an index of bias in ratings of surprised expressions with positive scores indicating an overall more fearful interpretation of the ambiguous expressions and negative scores indicating less fearful (happier) interpretation.

*Barratt Impulsiveness Scale (BIS-11; Patton, Stanford, & Barratt, 1995)* is a 30-item measure, assessing the personality and behavioural constructs of impulsivity, consisting of three subsfactors - motor, (in)attention and non-planning impulsivity. Responses were rated on a four-point Likert scale ranging from 1 = rarely/never to 4 = almost always/always. We chose BIS as our index of trait impulsivity, as opposed to a UPPS-P Impulsivity scale which includes indexes of emotional impulsivity (i.e., urgency; Cyders, Smith, & Spillane, 2007; Whiteside & Lynam, 2001), as BIS is well-characterised in alcohol research (Herman & Duka, 2019) and because previous studies using UPPS-P subscales highlighted high correlations between each other as well as almost identical correlates across various affective, cognitive, and behavioural measures and urgency subscales (Herman, Critchley, & Duka, 2018a; Sperry, Lynam, & Kwapil, 2018). Based on the high correlation between positive and negative urgency, the results obtained using these subscales would be difficult to interpret and may not represent the initial theoretical descriptions of positive or negative urgency.

*The Oviedo Infrequency Scale (Fonseca-Pedrero, Páino-Piñeiro, & Lemos-Giráldez, 2009)* is a 12-item measure developed to detect individuals that respond randomly, pseudo-randomly or dishonestly. Due to the online nature of the study, the scale was introduced to identify and exclude individuals who may not read questions carefully. Participants with three or more incorrect responses on this measure were removed from the sample.

*The Toronto Alexithymia Scale (TAS-20; Bagby, Parker, & Taylor, 1994)* is a 20-item self-report measure of alexithymia consisting of three factors: difficulties in identifying feelings, difficulties in describing feelings and externally orientated thinking. Responses were rated on a five-point Likert Scale ranging from 1 = strongly disagree to 5 = strongly agree. Scores  $\geq 61$  denote alexithymia, scores  $\leq 51$  denote non-alexithymia, and scores from 52 to 60 denote possible alexithymia (Taylor, Bagby, & Parker, 1997).

*Alcohol Use Questionnaire (AUQ; Mehrabian & Russell, 1978)* is a beverage-specific index of alcohol consumption, assessing both quantity and frequency of alcohol use, for the past six months. Binge Score (BS; Townshend & Duka, 2002) was calculated using the formula: (drinks per hour  $\times$  4) + (times drunk in last 6 months) + (percentage of times drunk

$\times$  0.2). As this method of BD assessment uses reports of drunkenness, as opposed to focusing simply the quantity and frequency of drinking, the scores are not adjusted by sex.

### 2.4. Data analysis

IBM SPSS Statistics 25 (IBM Corp. 2017) was used for data analysis, with PROCESS macro Version 3.3 (Hayes, 2018) for the mediation analysis.

First, to evaluate the relationships between measures of impulsivity, alcohol use and emotional processing, bivariate Pearson's correlations,  $r$ , two-tailed, were computed. We corrected all  $p$ -values for multiple comparisons using false discovery rate ( $p$ -FDR, Benjamini & Hochberg, 1995) using a script by A. Winkler (<https://s3.us-east-2.amazonaws.com/brainder/2011/fdr/fdr.m>) implemented in MATLAB.

Secondly, mediation models were computed to test the main hypothesis of the indirect effect of alexithymia on alcohol binge drinking through impulsivity. Adhering to Baron and Kenny (1986), we tested classic mediation criteria: (i) The predictor predicts the outcome—path  $c$ ; (ii) the predictor predicts the mediator—path  $a$ ; (iii) the mediator predicts the outcome while controlling for the predictor—path  $b$  (see Fig. 1). Statistical significances of the indirect effects were estimated using a bootstrapping method. To avoid biased estimations under conditions of nonnormality, bias-corrected confidence intervals (95%) were obtained with 5000 bootstrap resamples. Models were corrected for age and sex.

## 3. Results

### 3.1. Exclusions

177 participants completed the study. Three individuals had three or more incorrect responses on the Oviedo Infrequency Questionnaire suggesting inattention (Fonseca-Pedrero et al., 2009); therefore, they were excluded from the analyses entirely. The final sample included 174 students, aged 18 – 40 years old ( $SD = 3.24$ ); 122 were female with a mean age of 21.86 ( $SD = 3.01$ ) and 52 were male with a mean age of 22.42 ( $SD = 3.74$ ). The demographics is presented in Table 1.

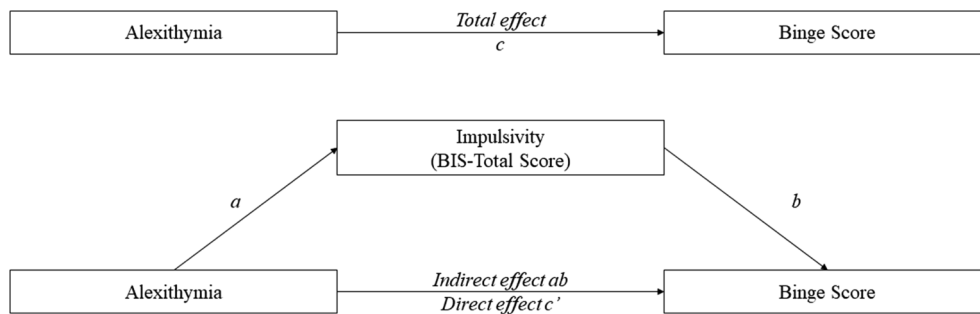
### 3.2. Inter-correlations

As presented in Table 2, impulsivity subscales were positively correlated with each other. BS positively correlated with all trait impulsivity measures, confirming that binge drinking is associated with elevated impulsivity. Alexithymia was positively correlated with BS as well as trait impulsivity measures (BIS Total score and BIS In-Attention), suggesting that increased self-reported problems in identifying emotions in self- and others are related to increased binge drinking and higher trait impulsivity, particularly in-attention subscale. Finally, VASem ratings were negatively associated with Binge Score (see Fig. 2), indicating that the higher the binge-drinking status, the surprised facial expressions were rated as less fearful (happier).

### 3.3. Mediation

Next, to test the hypothesised indirect effect of alexithymia on alcohol binge drinking through impulsivity, we run mediation analysis implemented with the PROCESS macro Version 3.3 (Hayes, 2018). Age and sex were also included as covariates in the analysis. The full results of the mediation analysis are summarised in Fig. 3.

To satisfy Baron and Kenny (1986) criteria, we first estimated the total effect of alexithymia on binge score (i.e., path  $c$ ). With no mediators in the model, the regression coefficient was statistically significant,  $b = 0.37$ ,  $SE = 0.12$ ,  $t(171) = 3.15$ ,  $p = .002$ . Alexithymia was also a significant predictor of trait impulsivity,  $b = 0.25$ ,  $SE = 0.06$ ,  $t(171) = 3.99$ ,  $p < .001$  (confirming path  $a$ ), and trait impulsivity was a



**Fig. 1.** Schematic representations of the mediation models of interest. The top panel shows the total effect of Alexithymia (TAS Total score) on alcohol consumption pattern (binge score). The bottom panel depicts indirect and direct effects of model Alexithymia (i.e., testing for mediation effect of trait impulsivity (BIS total score) on the relationship between Alexithymia and binge score.

**Table 1**  
Sociodemographic Characteristics and Questionnaires Scores of the Sample. TAS – Toronto Alexithymia Scale, BIS – Barratt Impulsiveness Scale.

Measure	N (%) or Mean	SD
Sex: Females	122 (70.1%)	
Sex: Males	52 (29.9%)	
Undergraduates	144 (85.6%)	
Postgraduates	25 (14.4%)	
Age	22.03	3.24
Tas Total	52.59	11.41
Binge Score	29.82	18.40
Bis (In)Attention	18.40	3.66
Bis Motor	23.51	4.15
Bis Non-Planning	25.22	4.45
Bis Total	67.13	9.83
Speed of Drinking [Drinks/Hour Per Drinking Session]	1.94	0.93
Times Drunk [%]	47.85	31.01
Alcohol Units Per Week	15.55	13.65
VASem Ratings	50.04	9.10

significant predictor of binge score,  $b = 0.46$ ,  $SE = 0.14$ ,  $t(170) = 3.25$ ,  $p = .001$  (confirming path b). These results support the mediation hypothesis. Alexithymia was still a significant predictor of binge score after controlling for the mediator, BIS Total,  $b = 0.26$ ,  $SE = 0.12$ ,  $t(170) = 2.14$ ,  $p = .034$  (path  $c'$ ), consistent with partial mediation. Approximately 18% of the variance in binge score was accounted for by the predictors ( $R^2 = 0.18$ ). The indirect effect was tested based on 5000 samples using bias-corrected and accelerated (BCa) 95% confidence intervals (Preacher & Hayes, 2004) showed that controlling for the covariates (age and sex), alexithymic features (TAS Total Score) had a

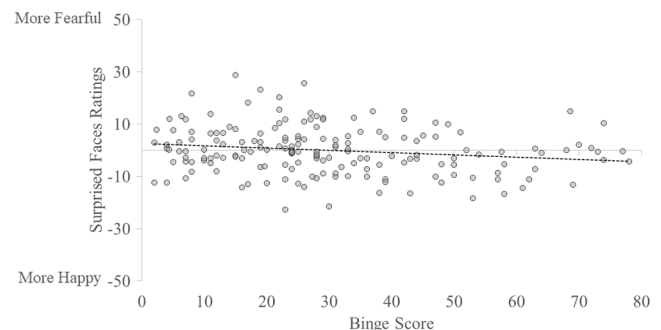
**Table 2**  
Correlations between trait impulsivity subscales, alcohol use indexes and emotion perception measures. Significant correlations (following FDR-correction for multiple comparisons) are depicted in bold.

		Alexithymia (TAS Total)	Binge Score	VASem ratings	BIS (In)attention	BIS Motor	BIS Non-planning
Binge Score	Pearson's r	0.285	—				
	p-value	<0.001	—				
	p-FDR	<0.001	—				
VASem ratings	Pearson's r	0.005	-0.179	—			
	p-value	0.946	0.018	—			
	p-FDR	0.974	<b>0.032</b>	—			
BIS (In)attention	Pearson's r	0.414	0.223	-0.150	—		
	p-value	<0.001	0.003	0.048	—		
	p-FDR	<0.001	<b>0.006</b>	0.073	—		
BIS Motor	Pearson's r	0.151	0.251	-0.017	0.387	—	
	p-value	0.047	<0.001	0.824	<0.001	—	
	p-FDR	0.073	<0.001	0.874	<0.001	—	
BIS Non-planning	Pearson's r	0.156	0.264	-0.143	0.381	0.598	—
	p-value	0.040	<0.001	0.061	<0.001	<0.001	—
	p-FDR	0.067	<0.001	0.089	<0.001	<0.001	—
BIS Total	Pearson's r	0.289	0.308	-0.128	0.708	0.837	0.847
	p-value	<0.001	<0.001	0.093	<0.001	<0.001	<0.001
	p-FDR	<0.001	<0.001	0.130	<0.001	<0.001	<0.001

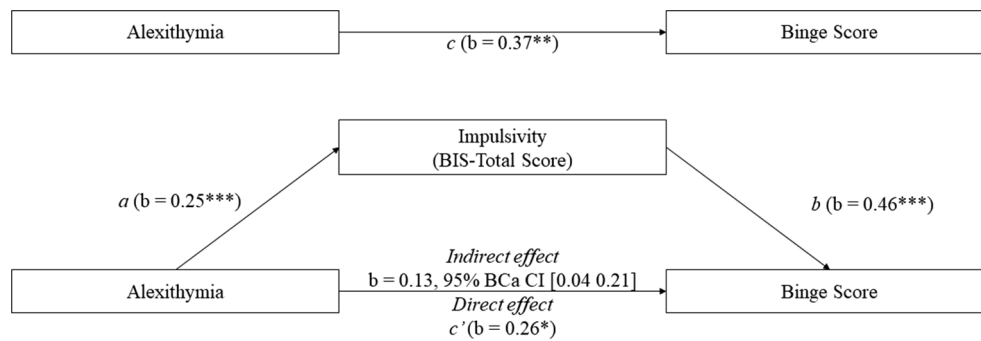
significant indirect effect (i.e., path  $ab$ ) on binge drinking via the mediator, trait impulsivity,  $b = 0.12$ ,  $Boot SE = 0.05$ , 95% BCa CI [0.036 0.209].

**4. Discussion**

This study investigated the combined role of trait impulsivity and experiencing difficulties in emotional processing in binge drinking, to further our understanding of their relationship to alcohol use in the student population. The key finding is that impulsivity partially mediates the relationship between alexithymic traits, assessed with TAS, and binge drinking in university students. Another important finding concerns ratings of emotional facial expressions: Higher binge-drinking



**Fig. 2.** The relationship between binge drinking status and ratings of facial expression on the VASem scale.



**Fig. 3.** Schematic mediation model of Alexithymia (TAS Total Score) as a predictor of Binge Score, mediated by Trait Impulsivity (BIS score) with age and sex as a covariate. The confidence interval for the indirect effect is a bias-corrected and accelerated (BCa) bootstrapped confidence interval (CI) based on 5000 samples.

among students was associated with less fearful (happier) ratings of surprised facial expressions.

Alexithymia exhibited an independent effect on trait impulsivity supporting the hypothesis that the inability to effectively identify and describe feelings contributes to disinhibited behaviours. As expected and in agreement with previous research (e.g., Thorberg et al., 2009; Betka, Pfeifer, & Garfinkel, 2017), we found that both alexithymia and trait impulsivity increase with elevated binge drinking, predicting binge score independently from each other. More specifically, investigating the relationships between these three components, our results supported the hypothesis of impulsivity as an intervening factor in the link between alexithymic traits and alcohol binge drinking, albeit only partially mediating their relationship. These results agree with past research showing that trait impulsivity partially mediates the effect of emotion dysregulation and alexithymia on alcohol use in mixed clinical as well as general populations (Garofalo & Velotti, 2015; Shishido et al., 2013). Together, these results suggest that poor emotional processing contributes to increased alcohol use, including student binge drinking, at least partially through the presence of impulsive trait that leads to behavioural disinhibition. Importantly, these findings highlight the potential utility of targeting emotion processing and self-control mechanisms simultaneously in prevention and intervention efforts aiming at reducing alcohol misuse in general as well as student populations.

In response to intense emotional arousal, rash action can provide a distraction from distress caused by the emotional arousal (Cyders & Smith, 2008). Individuals are, therefore, more likely to engage in impulsive behaviours – such as alcohol consumption – when they experience emotional distress, in an attempt to improve their mood (Tice, Bratslavsky, & Baumeister, 2001). This may occur especially frequently in alexithymic individuals, who report difficulties in identifying their own feelings as well as in differentiating between non-affective feelings and bodily sensations of emotional arousal (Brewer, Cook, & Bird, 2016; Sifneos, 1973). The alcohol use, especially intermittent drinking pattern seen in binge drinking, may then further exacerbate emotion deficits, generating a negative feedback loop of dependence (Kober, 2014).

Excessive alcohol use has been found to generate neurocognitive deficits. Research in rodents has shown that repeated alcohol consumption and withdrawal, similar to the pattern in binge drinking, alters the function of both the prefrontal cortex and the amygdala, areas fundamental to emotional processing (Stephens & Duka, 2008). This suggests that individuals that drink excessively may have reduced cognitive resources available to regulate their emotions and behaviour simultaneously. Therefore, when experiencing emotional arousal, alexithymic individuals may assign more cognitive capacity to emotion processing, subsequently leaving fewer resources available for executive control thereby increasing impulsive behaviours (Seo, Lacadie, & Sinha, 2016).

Regarding judgements of facial emotional expressions, surprise is an ambiguous emotion (e.g., Kim et al., 2003) and, therefore, we expected

that there may be significant differences across the binge drinking spectrum in terms of how they are interpreted. Indeed, we found a relationship with the severity of binge drinking: the higher the BD pattern, the *less fearful* the surprise expressions ratings.

The evidence regarding emotional processing deficits in binge drinkers so far has been mixed with some studies reporting impairments in that respect in binge drinkers, while other studies show intact emotion perception in binge drinkers (Huang et al., 2018; Lannoy et al., 2017, 2018b, 2018a, 2019; Maurage et al., 2013). On the other hand, alcoholics, both recently detoxified and longer-term abstinent individuals, consistently show deficits in facial expression recognition, particularly in the negative domain, but *overestimate* emotion intensity, which seems to be particularly related to fear ratings in various emotional expressions (Kornreich et al., 2001a, 2001b; Philippot et al., 2006; Townshend & Duka, 2003). Our results, seem to show the opposite pattern in young binge drinkers: Presented with ambiguous facial expressions (surprised) without any contextual information, higher binge drinking score was related to less fearful (happier) ratings. Our findings are in line with recent results showing that relative to non-binge drinkers, binge drinkers show *reduced* recognition of fear and sadness from morphed facial expressions (Lannoy, Benzerouk, & Maurage, 2019). The cross-sectional nature of our study prevents from making inferences about causal mechanisms. However, it seems likely that exaggerated perception of emotions in facial expression of negative emotions may be the consequence of chronic alcohol exposure in patients with AUD inducing negative emotional states (“dark side” of addiction; Koob & Le Moal, 2005). Our findings could also provide an interesting starting point for future research; for example, longitudinal studies tracking perception of emotional expressions in individuals at risk of developing AUD could be useful in determining the role of long-term alcohol use at emotion perceptions as well as the consequences of alterations in emotion processing for social interactions in daily life.

There are some limitations in our study that we would like to point out. It should be noted that we used a self-report measure to assess impulsivity. Self-report questionnaires may be limited in their ability to accurately assess individuals’ behaviours, as people generally do not have accurate self-knowledge (Mabe & West, 1982). Indeed, a dissociation between self-reported and objective measures of performance was recently reported in alcohol abuse (Jakubczyk, Skrzyszewski, & Trucco, 2019): AUD patients showed lower ability to accurately perceive physiological sensations (interoceptive accuracy) but presented enhanced perceived self-judgements of one’s abilities (interoceptive sensibility). Whether such dissociation is also present in binge drinkers and whether it is related to impulsivity or alterations in emotional processing remains to be tested. Future studies in this area could measure drinking using diary-based assessments and impulsivity levels using multiple behavioural measures, which tap onto distinct impulsivity dimensions, simultaneously (Herman et al., 2018b). The fact that we did not obtain information about psychopathologies, familial history of alcohol abuse, and other drug use, is a limitation as presence of comorbidities cannot be

excluded in our sample. Additionally, since we aimed to obtain data from a large group of students, we chose an online data collection paradigm. Consequently, the data collection setting was much less controlled than in a standard lab-based study. We made an effort to exclude any individuals who might not have been sufficiently attentive in the study; however, the lack of control over circumstances in which participants were completing the questionnaires can be considered a limitation. Finally, our sample consists of a majority of female participants; however, we believe that this is representative to the student population at our university.

As binge drinking is thought to be a risk-factor of later alcohol abuse (Chassin, Pitts, & Prost, 2002) and students show increased rates of alcohol consumption (Kypri, Cronin, & Wright, 2005), highly impulsive students may be at a greater risk of alcohol abuse disorders later in life. Preventative measures could be put in place for individuals that are found to be highly impulsive when they are younger. Our results indicate that the relationship between alexithymia, an emotional dysregulation trait, and binge drinking is partially mediated via trait impulsivity, suggesting that targeting emotional together with self-control processing, might prove a useful method for prevention of excessive drinking in student populations. We suggest that gaining insight into one's emotions and feelings may reduce an alexithymic individual's impulses to consume alcohol. Screening for both impulsivity and alexithymia might be particularly useful for identifying at-risk individuals early on.

## 5. Conclusions

To our knowledge, this is the first study to examine alexithymia and impulsivity together as contributors to the binge drinking pattern of alcohol consumption in a non-clinical sample. We showed that both alexithymia and impulsivity are related to binge drinking. Furthermore, we demonstrated that trait impulsivity partially mediates the relationship between alexithymia and binge drinking, suggesting that the consistently reported relationship between emotion-processing deficits and binge drinking is at least partly due to high impulsivity. We also reported differences across binge drinking spectrum in their trait impulsivity levels, alexithymic tendencies, and facial expression judgements.

Alcohol (over)consumption is a common public health issue reported in students. BD can be detrimental to students' well-being due to the numerous harmful consequences it may have on an individual and their academic studies. Therefore, in-depth understanding of the factors that underlie binge drinking in students, and their mutual relationship, will enable prevention and intervention efforts to be directed towards those at risk of alcohol-related problems.

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## CRediT authorship contribution statement

**AH:** Conceptualization, Formal analysis, Methodology, Project administration, Supervision, Visualization, Writing original draft, Writing - reviewing and editing. **TD:** Conceptualization, Funding acquisition, Methodology, Supervision, Writing - reviewing and editing. **NP:** Data curation, Investigation, Writing original draft.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence

the work reported in this paper.

## Data availability statement

Dataset generated in this study is available here: [https://osf.io/ws8b2/?view\\_only=d415879012c141c8b9383b87894d2bc3](https://osf.io/ws8b2/?view_only=d415879012c141c8b9383b87894d2bc3).

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