
Article

Impulsivity as a Multifaceted Construct Related to Excessive Drinking Among UK Students

A.J. Caswell^{1,2,*}, M.A. Celio², M.J. Morgan^{1,3,4}, and T. Duka^{1,3}

¹School of Psychology, University of Sussex, Brighton BN1 9QH, UK, ²Center for Alcohol and Addiction Studies, Brown University, Box G-S121-4, Providence, RI 02909, USA, ³Sussex Addiction Research and Intervention Centre (SARIC), School of Psychology, University of Sussex, Brighton BN1 9QH, UK, and ⁴Norwegian Center for Addiction Research, University of Oslo, Oslo, Norway

*Corresponding author: Center for Alcohol and Addiction Studies, Brown University, Box G-S121-4, Providence, RI 02912, USA. Tel.: +1-401-863-6637; E-mail: amy_caswell@brown.edu

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Abstract

Aims: A substantial number of university students exceed alcohol guidelines. Impulsivity has been repeatedly implicated in heavy alcohol use, yet despite knowledge that impulsivity is multifaceted, there have previously been few studies applying multiple measures of self-report and behavioural impulsivity to examine the relationship with excessive student drinking. This results in a limited understanding of the relationship of various facets of impulsivity to student drinking.

Methods: Participants completed a comprehensive battery of impulsivity measures: the Barratt Impulsiveness Scale as a self-report index and the Stop Signal Task, Information Sampling Task and Monetary Choice Questionnaire as behavioural measures of three facets of impulsivity. Participants who exceeded UK drinking guidelines were compared to those who did not on measures of impulsivity. Hierarchical linear regression was then employed to test whether indices of impulsivity were associated with the average units consumed per week.

Results: Participants who exceeded UK guidelines reported increased impulsivity in facets of self-report impulsivity. They also displayed performance deficits in normal adjustment of Go responses on the Stop Signal Task. In the regression model, nonplanning impulsivity on the Barratt Impulsiveness Scale was seen to predict quantity of alcohol consumed per month.

Conclusions: The study applies a comprehensive selection of behavioural and self-report measures of impulsivity and indicates that excessive drinkers are more impulsive in some but not all aspects. The results indicate that the wide range of deficits apparent in alcohol-dependent individuals are not evident in this younger, heavy drinking population, but that specific performance and self-identified deficits are already apparent.

INTRODUCTION

Alcohol is arguably the most commonly abused drugs in human history (Fillmore, 2007), and is an ever growing problem, particularly in student populations. Undergraduate students have been reported to drink more than both adults and young adults who do not attend university (Balodis *et al.*, 2009) and a substantial number of both US (Beseler *et al.*, 2012) and UK (Gill, 2002) university students exceed government guidelines on alcohol intake and

report heavy episodic drinking. This excessive consumption not only has significant academic and financial implications for the students concerned (Bewick *et al.*, 2008; Atwell *et al.*, 2011) but is also a major public health concern especially when considering that alcohol use disorder diagnoses and alcohol-related harms including unintentional injury, driving under the influence, alcohol-related assault, and death have been found to be on the rise in university students (Hingson *et al.*, 2002).

In light of this, an increasing number of alcohol interventions have been developed based on risk factors identified in the literature (Atwell *et al.*, 2011). One process that has been repeatedly implicated in alcohol use, as well as other drug use, is impulsivity (e.g. Jentsch and Taylor, 1999). Impulsivity is a multifaceted construct, reflecting a tendency of individuals to act prematurely or without fully weighing the consequences of their behaviour (Caswell *et al.*, 2015). Alcohol-dependent individuals consistently exhibit elevated impulsivity (Bjork *et al.*, 2004) and a recent study has found that impulsivity recorded in young adolescents predicts alcohol consumption 6 months later (Ferne *et al.*, 2013), leading researchers to suggest that impulsivity may contribute to both the initiation of alcohol use and be further exacerbated by neurobiological changes caused by heavy alcohol consumption (e.g. Jentsch and Taylor, 1999).

Traditionally impulsivity has been indexed by self-report measures, which aim to identify different facets of impulsivity, for example the Barratt Impulsiveness Scale (Patton *et al.*, 1995), with high levels of self-reported impulsivity identified amongst university drinkers (e.g. Magid *et al.*, 2007; Adams *et al.*, 2012; Jones *et al.*, 2014). While these studies suggest impulsivity is related to increased drinking, not all research paints such a straightforward picture, with others finding only limited evidence of elevated self-report impulsivity in heavy drinkers (Balodis *et al.*, 2009; Henges and Marczinski, 2012).

Furthermore, self-report measures are constrained by reliance on self-awareness and introspection (Helmers *et al.*, 1995; Evenden, 1999) with more recent research focusing on experimental paradigms to index behaviourally observable impulsive responding. Investigators have focused on three behavioural subtypes relating to impulsivity; the inability to inhibit a behavioural response is referred to as 'motor'-impulsivity; 'reflection'-impulsivity refers to the tendency to make decisions without gathering or evaluating necessary information; and finally 'temporal'-impulsivity, more commonly referred to as 'delay discounting', as the preference for immediate gratification. While these are all referred to under the umbrella term 'impulsivity' there is consensus that they refer to a range of behavioural and cognitive processes and may be better conceptualized as heterogeneous sub-facets conferring unique mechanisms of risk for alcohol and other drug use (Winstanley *et al.*, 2006; Dick *et al.*, 2010; Badiani *et al.*, 2011); for detailed commentaries see (Evenden, 1999; Dick *et al.*, 2010).

In light of this, to fully understand the relationship of impulsivity to alcohol use, it is important to identify the association between alcohol use and *specific* subtypes of impulsivity. While it has been long established that heavy drinkers display a variety of cognitive and behavioural deficits (e.g. Scaife and Duka, 2009), behavioural indexes of impulsivity subtypes have only been recently utilized in student populations. There is emerging evidence that university student binge drinkers may display increased reflection-impulsivity (e.g. Townshend *et al.*, 2014) and temporal-impulsivity (Sanchez-Roige *et al.*, 2014), and that they also display deficits on a novel task thought to measure a 'waiting-impulsivity' subtype (Sanchez-Roige *et al.*, 2014). However, not all research indicates a consistent relationship between drinking and impulsivity, with a recent study finding inconsistent impairments in reflection-impulsivity and no impairments in temporal-impulsivity in young adult binge drinkers (Banca *et al.*, 2015), and another finding that binge drinkers were not impaired on an index of motor-impulsivity (Sanchez-Roige *et al.*, 2014).

Collectively, these studies suggest that there may not be a consistent relationship between subtypes of impulsivity and student alcohol consumption. While this potentially supports the suggestion that impulsivity is best conceptualized as multifaceted with heterogeneous

relationships to alcohol and drug use, the tendency of researchers to apply only one index of impulsivity limits our ability to identify whether the different relationships are an artefact of different populations or indeed a true representation of the multifaceted nature of impulsivity. Despite knowledge that the subtypes may differentially relate to drug use (Meda *et al.*, 2009) there are only a limited number of comprehensive and concurrent evaluations of multiple facets of impulsivity as relating to student alcohol consumption. The more common practice of selecting single indexes of impulsivity and extrapolating the results to account for 'impulsivity' as a whole has limited our understanding of how this complex construct is related to alcohol use.

In light of this, the current study will implement both self-report and behavioural measures of impulsivity to simultaneously examine the association between multiple facets of impulsivity and alcohol use among college students. Students exceeding UK weekly guidelines as recommended by the UK Royal College of Physicians' guidelines (14 units of alcohol per week for women and 21 units per week for men, Royal College of Physicians, 2011) will be compared to those who do not on the Barratt Impulsiveness Scale as a self-reported index of subtypes of impulsivity, as well as a comprehensive battery of behavioural measures indexing reflection-, motor- and temporal-impulsivity. The guidelines set out by the Royal College of Physicians were selected as the more conservative guideline compared to the UK government guidelines (Royal College of Physicians, 2011) and as our index of alcohol use reflects weekly, rather than daily consumption.

METHODS

Participants

151 (78 females, 73 males) individuals aged 18–25 were recruited from the University of Sussex student subject pool. The sample consists of a subset of young adults from a larger sample ($N = 160$) aged 18–45, details of which are published in Caswell *et al.* (2015). The sample age limit of 25 was selected to maintain consistency with recently published literature exploring the relationship between impulsivity and age (Jones *et al.*, 2014; Sanchez-Roige *et al.*, 2014).

Procedure

Participants were recruited using the University of Sussex subject pool, an online system allowing registered participants to read brief information about the study and to sign up for a timeslot online. Students from across the university were able to sign up to the subject pool, with no obligation to participate in studies; students within Psychology were required to sign up to the pool to complete a minimum number of studies to obtain course credit.

Before coming to the laboratory participants were instructed to not drink alcohol for at least 12 h before the test session and to not take illicit drugs for the week preceding the session.

On the day of the session, participants came to the laboratory and were given an information sheet and the opportunity to ask questions before giving informed consent. They then provided demographic information and completed the Alcohol Use Questionnaire and National Adult Reading Task followed by the self-report measure of impulsivity, the Barratt Impulsiveness Scale, as part of a questionnaire pack. Participants then moved to a cubicle containing a desktop computer, where they completed the three behavioural measures of impulsivity: reflection-impulsivity (the Information Sampling Task), temporal-impulsivity (the Monetary Choice Questionnaire) and motor-impulsivity (the Stop Signal Task). For full details of tasks including individual

procedures and instructions please see ‘Materials’. Tasks were completed amongst a larger battery of tasks and questionnaires. Behavioural tasks were computerized and completed in a random order.

Participants were compensated for their participation at a rate of £5/hour or 4 course credits per hour. The protocol lasted ~2 h and 15 min. Following the study participants were debriefed and were given experimenter contact details. Participants were excluded had they completed any studies using the same tasks within the same laboratory.

The study was approved by the University of Sussex ethics board.

Materials

Demographics: Participants record their age and gender and whether English is their first language.

Alcohol Use Questionnaire (AUQ; Townshend and Duka, 2002): Participants give an estimation of alcoholic drinks consumed per week. The questionnaire gives a measure of total units per week. Units per week are adjusted using the type of drink reported; a pint of beer was calculated at 2.4 units, a glass of wine at 1.5, a drink of spirits at 1 and an alcopop at 1.7 units.

National Adult Reading Task (NART; Nelson and O’Connell, 1978): The National Adult Reading Task is a list of 50 short, irregular words of increasing complexity. Participants read down the list, attempting every word; there is no time limit. Participants are not required to complete the task if they are dyslexic or second language English speakers. Number of errors in pronunciation gives an estimate of verbal IQ.

Measures of impulsivity

Barratt Impulsiveness Scale, Version 11 (BIS-11; Patton et al., 1995): The BIS-11 is a 30-item checklist measuring impulsivity. Responses to a series of statements are made on a five-point Likert scale ranging from disagree strongly to agree strongly. The questionnaire gives a total score, as well as three sub-scores of motor, attentional and nonplanning impulsivity.

Information Sampling Task (IST; Clark et al., 2006): The Information Sampling Task assesses information sampling before decision-making. On each trial, a matrix of 5×5 grey squares is presented. Participants click on squares to reveal one of two colours until they decide which colour is in the majority. Participants open as many boxes as they wish at their own rate. Boxes remain open for the duration of the trial. Participants express their decision by selecting one of two coloured boxes at the bottom of the screen, winning or losing 100 points if correct or incorrect. The minimum inter-trial interval between trial onsets is 30 s. Participants complete 10 trials. The primary index of impulsivity (P_{correct}) is the probability of being correct that the participant tolerates at the point of decision-making. Participants who tolerate more uncertainty at the point of decision-making are considered more impulsive. In addition, the task provides an index of the number of incorrect choices participants make (errors). This variable provides additional information as a participant can acquire full information and still make an error when they make their colour choice.

Stop Signal Task (SST; Logan, 1994): The Stop Signal Task assesses inhibitory control of a pre-potent motor response. Participants are instructed to respond using button presses to the direction of a visually presented green arrow (Go signal) but to withhold this response whenever the arrow changes from green to red (a Stop Signal, occurring on 25% of trials). On each trial, a fixation cross is presented for 1200–1500 msec. The Go signal is then presented, which either

remains on screen for 800 msec, or is replaced, after a variable stimulus onset asynchrony (SOA) by a Stop stimulus (red arrow). Initial Stop Signal is presented at a delay of 200 msec but is then adjusted using a staircase procedure: when the participant successfully stops to a Stop Signal the subsequent SOA is increased by 50 ms; if the participant fails to stop then the SOA is reduced by 50 ms. Participants completed 20 practice trials and 120 experimental trials. The main index of impulsivity is Stop Signal Reaction time (SSRT). SSRT estimates the duration of the Stop process—individuals with good inhibitory control have shorter Stop processes, whereas more impulsive individuals have longer Stop processes. SSRT was calculated using the integration (SSRTi) method (see Verbruggen et al., 2013 for details). While the primary SSRT index gives an estimate of the Stop process, information on the Go process can also be extracted from Go reaction times (Go RTs). Within Go reaction times, Go RTs on the trial immediately following failed Stop trials (i.e. Stop trials where the participant unsuccessfully inhibited their Go response; GoRTs after unsuccessful stops) can be calculated; these trials are important indicators of whether the participant adjusts their responding following failed stops.

Monetary Choice Questionnaire (MCQ; Kirby et al., 1999): The Monetary Choice Questionnaire measures preference for large delayed rewards over small, more immediate rewards. Participants complete 27 items. For each item, participants must choose between a large delayed reward (LDR), and a smaller more immediate reward (SIR). All rewards are hypothetical. The task gives an estimate of participants discounting parameter (k), using the pattern of choices across the 27 items. k values for each choice on the questionnaire can be calculated using the formula $((\text{LDR} - \text{SIR}) - 1) / \text{delay}$. k values give information on whether the participant prefers smaller sooner rewards (i.e. is more impulsive) or whether they choose larger later rewards (less impulsive).

Analysis plan

Descriptive statistics were employed to examine all variables of interest and determine whether they were appropriate for parametric analyses, with transformations used if appropriate. To explore group-level differences between students who exceed guidelines for alcohol consumption, participants were categorized as exceeding guidelines (>14 units/week for women and >21 units/week for men, calculated from the AUQ using the aforementioned adjustment for type of drink) or not exceeding guidelines. Independent-samples t -tests were employed to compare these groups on the primary index of impulsivity from each task (SSRT, P_{correct} , k value) as well as a number of secondary indices: SST GoRTs, SST GoRTs after unsuccessful stops and IST errors. These additional indices were included as further variables of interest that are not the primary impulsivity index of each task, but may be related to heavy alcohol use in other, clinical populations (e.g. Lawrence et al., 2009a,b).

Hierarchical linear regression was employed to test whether individual differences in self-report and behavioural indices of impulsivity are associated with units of alcohol consumed per week after controlling for relevant a priori covariates. Age, gender and IQ were explored as a priori covariates of interest. Self-report measures of impulsivity, specifically the BIS-11 attention, motor, and nonplanning subscales, and the primary indices on the SST (SSRT), IST (P_{correct}) and MCQ (k value) as behavioural measures of impulsivity were entered in the second level of the model. Collinearity diagnostics and residual plots were examined to assess for model violations (e.g. multicollinearity, nonlinearity and heteroscedasticity). Throughout all analyses,

$P \leq 0.05$ was interpreted as statistically significant. Effect sizes were reported as β .

All analyses were conducted using SPSS v.20.0. (IBM, Armonk, NY).

RESULTS

BIS-11: Data were missing for one participant. **SST:** Data were missing for three participants; an additional nine participants were excluded for GoRTs > 1000 msec, or 100% Stop accuracy. **MCQ:** Data for three participants were missing. A total of 139 participants were included in the final analysis. Of the participants 121 completed the NART.

SST, SSRT and MCQ k values were log transformed address issues of non-normality.

Participant demographics

See Table 1 for details of participant demographics.

Group-level comparisons

When comparing students who exceeded guidelines to those who do not, excessive drinkers reported higher BIS-11 motor scores ($t(137) = -2.438, P = 0.016$) and higher BIS-11 nonplanning scores ($t(137) = -2.664, P = 0.009$). They also displayed faster Go times after failing to Stop on a Stop trial immediately before ($t(137) = 1.983, P = 0.049$). Supplementary analysis indicated that drinkers who did not exceed guidelines made significantly slower Go responses after failed stops compared to average Go RTs ($t(86) = -2.541, P = 0.013$) whereas excessive drinkers did not alter their responses ($t(51) = 0.890, P = 0.377$).

There were no differences on any other tasks. For descriptive values and full statistics see Table 2.

Hierarchical linear regression analyses

As indicated, age, gender, and IQ were examined as a priori covariates. Age and IQ were not significantly associated with any dependent variables of interest, and were therefore excluded from the remaining analyses. The results (presented in Table 3) indicated that the covariate model (i.e. level 1) explained ~12% of the variance in units consumed per week, $R^2 = 0.083, F(1,137) = 8.812.3656, P < 0.001$. Specifically, quantity of drinking was negatively associated with gender ($\beta = 0.288, P < 0.001$), suggesting that males drink more than females. When indices of impulsivity were added to the model (i.e. level 2), these indices accounted for an additional 9% of the variance in quantity of drinking, $\Delta R^2 = 0.085, F(6,131) = 2.218, P = 0.045$. Specifically, quantity of drinking was significantly and positively associated with BIS-11 nonplanning ($\beta = 0.288, P = 0.004$), but no other index of impulsivity (see Table 3 for details). Collinearity diagnostics and residual plots found no evidence of model violations.

DISCUSSION

While the assumption of an association between impulsivity and risky alcohol consumption is pervasive, our results indicate the relationship is specific to certain facets of impulsivity. Participants who reported an average weekly consumption of alcohol that exceeded UK guidelines showed performance deficits in facets of self-report impulsivity—specifically the motor and nonplanning subscales on the Barratt Impulsiveness Scale—as well as impairment in adjustment of behavioural responses on the Stop Signal Task, but not on other indexes of impulsivity.

The results recorded on the Stop Signal Task provide exciting new insights into the relationship of student drinking to motor-impulsivity.

Table 1. Demographic values for the entire sample and for the sample categorized as exceeding UK guidelines (excessive drinkers) and those who do not (low drinkers)

	Entire sample ($n = 139$)			Low drinkers ($n = 87$)			Excessive drinkers ($n = 52$)		
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
Age	20.14	1.67	18–25	20.34	1.74	18–25	19.79	1.45	18–25
IQ ($n = 121$)	107.88	6.86	90–124	108.19	6.95	90–124	107.37	6.76	93–121
Units per week	16.67	14.07	0–72.40	8.13 ^a	4.87	0–18	30.95 ^a	12.78	14.75–72.40

^aIndicates a significant difference between excessive and low drinkers, $P < 0.001$.

Table 2. Summary statistics comparing excessive and low drinkers on measures of impulsivity

	Low drinkers ($n = 87$)	Excessive drinkers ($n = 52$)	P	Cohen's d
Barratt Impulsiveness Scale				
Attentional subscale	17.31 \pm 4.17	17.60 \pm 3.54	$t(137) = -0.416, P = 0.678$	0.075
Motor subscale	22.92 \pm 4.03	24.58 \pm 3.65	$t(137) = -2.428, P = 0.016^a$	0.431
Nonplanning subscale	23.40 \pm 4.81	25.69 \pm 5.05	$t(137) = -2.664, P = 0.009^a$	0.464
Stop Signal Task				
SSRT	277.45 \pm 76.86	258.31 \pm 62.08	$t(137) = 1.445, P = 0.151$	0.274
GoRT	632.48 \pm 114.95	617.79 \pm 109.77	$t(137) = 0.741, P = 0.460$	0.131
GoRT after incorrect stop	654.48 \pm 150.39	606.21 \pm 117.01	$t(137) = 1.983, P = 0.049^a$	0.358
Information Sampling Task				
Pcorrect	0.88 \pm 0.10	0.89 \pm 0.10	$t(137) = 0.277, P = 0.782$	0.100
IST errors	1.20 \pm 1.21	1.08 \pm 1.22	$t(137) = 0.558, P = 0.578$	0.099
Monetary Choice Questionnaire				
k value	0.02035 \pm 0.03336	0.02005 \pm 0.01874	$t(137) = -1.320, P = 0.189$	0.011

Values represent mean \pm S.D. The assumption of equal variances was met for all tests.

^aIndicates significant difference between excessive and low drinkers, $P < 0.05$.

Table 3. Regression analyses examining impulsivity variables as predictors of the average number of units consumed per week

Model Variable	Level 1: covariate model					Level 3: behavioural measures				
	B	SE	Beta	t	P	B	SE	Beta	t	P
Gender	8.072	2.296	0.288	3.516	0.001	9.39	2.333	0.335	4.024	0.000
Barratt Impulsiveness, Attentional subscale						-0.536	0.341	-0.149	-1.573	0.118
Barratt Impulsiveness, Motor subscale						0.215	0.329	0.06	0.652	0.516
Barratt Impulsiveness, Nonplanning subscale						0.808	0.277	0.288	2.917	0.004 ^a
Stop Signal Task, SSRT						-17.428	10.492	-0.137	-1.661	0.099
Information Sampling Task, Pcorrect						-7.287	11.535	-0.052	-0.632	0.529
Monetary Choice Questionnaire, k value						-0.641	1.981	-0.027	-0.324	0.747

^aIndicates variable is a significant predictor of the number of units of alcohol consumed per week, $P < 0.01$.

Despite the known effects of acute alcohol as impairing inhibitory control (Caswell *et al.*, 2013), Stop Signal Reaction times on the Stop Signal Task were not associated with drinking quantity indicating that inhibitory control on the task is not necessarily associated with higher levels of student drinking. Interestingly though, heavier drinkers did show impairments on adjusting their responses after making an incorrect response on the task; while participants who did not exceed alcohol guidelines slowed their responding after failing to Stop on a Stop trial, participants who exceeded guidelines did not adjust their responding. Research has indicated that control subjects make response strategy adjustments after failing to Stop by slowing the Go response to increase subsequent stopping ability (Verbruggen and Logan, 2008; Bissett and Logan, 2012). The failure to slow Go responses after failed Stop trials has been observed in alcohol-dependent individuals, who also display longer SSRTs (Lawrence *et al.*, 2009a). The current results provide exciting evidence that the failure to adjust response strategy after failing to Stop may be an early marker of heavy use (although it is unclear whether this precedes alcohol use) with impaired inhibitory control potentially arising from more long-term heavy use.

The results indicate that aspects of self-reported impulsivity on the Barratt Impulsiveness Scale are related to excessive alcohol consumption amongst students. Participants categorized as excessive drinkers recording higher nonplanning scores when compared to lower drinkers; this facet of self-reported impulsivity was also found to predict drinking in the regression model. Individuals who exceeded guidelines also recorded higher Barratt Impulsiveness motor scores, an aspect of impulsivity that was not identified as significant in the regression model. This relationship between self-reported impulsivity and excessive drinking is consistent with previous research identifying such a relationship in students (Fossati *et al.*, 2001), and indicates that students reporting higher levels of impulsivity may be at risk for excessive drinking. Nonplanning impulsivity was the only facet of self-reported and behavioural impulsivity seen to predict drinking in the regression models, indicating that this facet of self-reported impulsivity may have particular relevance for heavy alcohol use among students. The results suggest that this facet of impulsivity may reflect a greater risk for excessive drinking and that targeting this facet of self-identified impulsivity may have an impact on reducing heavy use.

The absence of a relationship between behavioural measures of reflection- and temporal-impulsivity and university drinking is important. Impulsivity has been repeatedly implicated in the initiation and maintenance of alcohol use (amongst other drugs) (e.g. Jentsch and Taylor, 1999; Balodis *et al.*, 2009) and there are consistent findings of impulsivity related deficits in alcohol-dependent individuals (e.g. Petry, 2001; Bjork *et al.*, 2004; Lawrence *et al.*, 2009a,b; Joos *et al.*, 2012). While there has previously been some preliminary evidence

of a relationship between reflection-impulsivity and alcohol use (Townshend *et al.*, 2014) and also between preference for immediate rewards and alcohol use (Yankelevitz *et al.*, 2012), behavioural measures of impulsivity have not been extensively utilized to explore the relationship between impulsivity and student drinking. The lack of a relationship between these two facets of impulsivity and excessive alcohol use, compared to the deficits observed in self-reported impulsivity and behavioural regulation, strengthens the understanding that impulsivity cannot be considered a unitary construct and instead that different subtypes may be differentially related to alcohol use (Dick *et al.*, 2010). The results provide new evidence that these two facets of impulsivity are not necessarily associated with alcohol consumption amongst student populations. It is possible, however, that there may be alternative task based explanations for the lack of a relationship between the tasks and student drinking. For example, it may be that the Monetary Choice Questionnaire is a relatively simple measure of temporal-impulsivity that employs hypothetical rewards—had we used monetary rewards we may have found different results.

The results suggest that the wide ranging deficits observed in alcohol-dependent individuals may either arise from the heavy long-term patterns of use they display, or are specific to only a small fraction of individuals who later become alcohol dependent. It appears that in our population of hazardous drinkers under the age of 25, any deficits are specific to certain facets of impulsivity. One of the study's key strength is the categorization of participants as excessive or low drinkers according to the UK guidelines and whether we view these impulsivity related deficits as a cause or consequence of the excessive use, we can see potential avenues for intervention. If the results are taken as providing evidence of the damaging effects of heavy use at a young age, the study provides evidence to suggest that guidelines should be lowered. Alternatively, if it is interpreted that these impairments may contribute to the initiation of heavy use, interventions targeting these specific processes may support reduction of heavy alcohol use.

However, while the study provides a comprehensive account of the association between impulsivity and excessive student drinking, it only provides a picture of the relationship of units consumed per week. There are further important alcohol-related variables, for example age of drinking onset (Dougherty *et al.*, 2004) that may have been useful to further identify the relationship between impulsivity and drinking. It must also be highlighted that whilst there were significant impairments recorded in excessive drinkers, the effect sizes for these differences were in the small to moderate range, suggesting that these facets may play a relatively minor role in vulnerability to excessive drinking.

Research has indicated that impulsivity may play a very different role depending on the drug in question (Badiani *et al.*, 2011). In light of this, we cannot extrapolate the current findings beyond the

alcohol use. Future research should consider exploring whether the different facets of impulsivity discussed in this study, are differentially related to such other types of drug use within student populations.

In conclusion, the association between impulsivity and risky alcohol consumption is persistent. Impulsivity has been repeatedly implicated as both a cause and consequence of alcohol and drug use with findings from alcohol-dependent individuals frequently cited to support for this. The current study instead suggests that a relationship between impulsivity and alcohol use amongst hazardous student populations is specific to certain aspects of impulsivity. We are the first to apply a comprehensive range of behavioural and self-report measures of impulsivity in a UK student population and the results indicate that future investigations—especially those studying potential routes for intervention for excessive drinking—should account for the multifaceted nature of impulsivity.

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CONFLICT OF INTEREST STATEMENT

None declared.

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