Binge drinking, reflection impulsivity, and unplanned sexual behavior: impaired decision-making in young social drinkers

Binge drinking, reflection-impulsivity and unplanned sexual behaviour: Impaired decision-making in young social drinkers.

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Abstract

Background. The repeated pattern of heavy intoxication followed by withdrawal from alcohol (i.e., 'binge drinking') has been found to have substantial adverse effects on prefrontal neural systems associated with decision-making and impulse control. Repeated binge drinking has been linked to risky and unplanned sexual behaviour, however few studies have examined the role of impulsivity and related cognitive processes in understanding this association. The aim of this study was to examine the relationship between binge drinking, 'reflection-impulsivity' (deficits in gathering and evaluating information during decision-making), alcohol-related expectancies and unplanned sexual behaviour in a sample of university students.

Methods. Ninety-two university students completed the Alcohol Use Questionnaire (AUQ) to measure alcohol intake and binge drinking. Two groups (low binge, high binge) were generated from the AUQ data. The Information Sampling Task (IST: Cambridge Cognition Ltd.) was used to measure reflection-impulsivity; the Alcohol Expectancy Questionnaire (AEQ) for alcohol outcome expectancies; and an Unplanned Sexual Behaviour questionnaire, which asked about the number of unplanned sexual events.

Results. When compared with the low-binge drinking group, the high-binge drinkers had significantly more unplanned sexual encounters and were impaired on the IST, reflection-impulsivity task. They scored higher on the alcohol expectancy factors of Sociability, Risk and Aggression, Negative Self-perception, and in particular Liquid Courage. In a regression analysis, number of unplanned sexual encounters, binge drinking score, and Liquid Courage were all significantly related.

Conclusions. These results support the role of binge drinking in reduced impulse control and decision-making deficits. The findings indicate that heavy binge drinkers demonstrate impairments on an impulse control task similar to that observed in dependent samples and this may be a factor in understanding the negative behavioural consequences associated with excessive alcohol use.

Keywords: Binge-drinking, reflection-impulsivity, expectancies, unplanned sexual behaviour, Information sampling task.

1. Introduction

Binge drinking has been defined as the consumption of five or more drinks for men and four or more drinks for women within two hours (Courtney & Polich, 2009) and represents a particularly problematic, yet highly prevalent pattern of consumption amongst young adults (e.g., Archie et al., 2012; Courtney & Polich, 2009). Specifically, a range of studies have indicated that the binge drinking pattern is associated with numerous adverse psychological and health related outcomes (e.g., Carlson et al., 2010). For example, binge drinkers are more at risk of alcohol-related problems relating to impulsive behaviour, drink driving, alcohol dependence, unplanned and risky sexual behaviour, and associated health, social and economic consequences (Miller et al., 2007; Orchowski et al., 2012; Wechsler et al., 2000).

Of particular concern is that the binge pattern of consumption appears to have deleterious effects on neural functioning (Lopez-Caneda et al., 2013; Maurage et al., 2012). That is, the repeated pattern of heavy intoxication followed by withdrawal from alcohol has been found to have substantial adverse effects on prefrontal neural systems associated with decision-making and inhibitory control (Hermans et al., 2012; Maurage et al., 2012), a finding consistent with studies into the neurotoxic effects of illicit drugs (e.g., Goldstein & Volkow, 2011; Jenstch & Taylor, 1999). Thus, neurobiological evidence suggests that not only is binge drinking problematic due to the amount of alcohol consumed but more so due to the specific pattern of intense use in a short period of time (Hermans et al., 2012).

However, from a methodological perspective, disentangling overall quantity of consumption from drinking pattern presents a difficult task. In an attempt to discriminate between different drinking patterns, Maurage et al. (2012) compared three drinking groups and a control group on specific event related potentials (ERPs) pertaining to cognition and decision making. Two of the drinking groups consumed the same overall amount of alcohol per week (15-29 units) but, critically, differed in terms of consumption frequency. Specifically, the

'moderate binge' group consumed 5-12 drinks in 2-3 drinking sessions, whilst the 'daily drinkers' consumed 3-5 drinks in 5-7 drinking sessions. A third drinking group 'intense binge' comprised individuals who consumed over 30 drinks per week and were included to examine the effects of overall quantity of use. Findings indicated that, when compared to the daily drinkers, the moderate binge group displayed significant neural deficits as assessed by the ERPs (Maurage et al., 2012). Thus, despite reporting the same overall weekly consumption as the daily drinkers, the moderate binge drinkers were characterised by impairments in neural functioning. This finding provides support for the proposal that the binge *pattern* of alcohol consumption may have particular ramifications for specific neural processes. Indeed, these results are in accordance with broader evidence demonstrating the deleterious effects of excessive substance use on prefrontal areas responsible for decision making, inhibitory control and impulsivity (Dawe et al., 2007; Duka et al., 2004; Jentsch & Taylor, 1999; Hermans et al., 2012; Townshend & Duka, 2005).

Thus, the finding that repeated intense alcohol consumption affects prefrontal neural systems responsible for impulse control (e.g., Jentsch & Taylor, 1999; Cardenas et al., 2007; Goldstein & Volkow, 2011) is consistent with findings from studies implicating impulsivity-related personality traits as correlates of drinking behaviour (e.g., Dawe et al., 2007; VanderVeen et al., 2013). Interestingly, measures of impulsivity have also shown to prospectively predict early experimentation with alcohol (e.g., McGue et al., 2001; Tarter et al., 2004) and evidence also indicates that chronic use exacerbates impulsivity by impairing neural systems responsible for impulse control in a similar manner to that seen in patients with prefrontal cortex lesions (orbitofrontal area; e.g., Bechara & Damasio, 2002; Verdejo-Garcia & Bechara, 2008). Taken together, these findings suggest that impulsivity is a particularly relevant individual difference variable in understanding both the development and maintenance of binge drinking behaviour (e.g., Gullo & Dawe, 2008). That is, a

heightened trait level of impulsivity may confer a predisposition toward excessive alcohol use (McGue, et al., 2001; Tarter et al., 2005) and ongoing chronic consumption may further exacerbate impulsive behaviour (e.g., de Wit, 2009) and thus increase binge drinking by damaging neural systems responsible for impulse control (Balodis et al., 2010; Clark et al., 2009; Jenstch & Taylor, 1999).

However, evidence indicates that impulsivity is a multidimensional construct (see Evenden, 1999) and various definitions have been proposed as relevant to understanding drinking behaviour. Most studies have primarily focused on conceptualisations pertaining to rashness (i.e., spur of the moment behaviour, disregard for negative consequences) and/or reward sensitivity (i.e., increased sensitivity to and approach toward appetitive stimuli; Franken, 2002; Gullo et al., 2010, Kambouropoulos & Staiger, 2007). Of interest to the present investigation however is a relatively unstudied aspect of impulsiveness which may be of particular relevance to the study of binge drinking. Specifically, 'reflection impulsivity' (Kagan, 1966), deficits in the gathering and evaluation of information during the decision making process (Solowij et al., 2012) may be critical to understanding the binge pattern of consumption and associated negative consequences.

Indeed, using a behavioural task specifically designed to measure the ability to gather and evaluate all available information (e.g., Information Sampling Task – IST; Cambridge Cognition Ltd.), significantly reduced reflection has been found in chronic cannabis users (Clark et al., 2009), and in current users of amphetamines and opioids (Clark et al., 2006). Similarly, Lawrence et al. (2009) found that alcohol dependent individuals displayed significantly lower levels of reflection on the IST relative to a sample of healthy control participants. Fewer studies have examined the relationship between reflection impulsivity and binge drinking, however the available evidence indicates that binge drinkers also display deficits in inhibitory control on similar behavioural tasks (e.g., Henges & Marczinski, 2012;

Townshend & Duka, 2005). Thus, while limited, evidence suggests that a reduced capacity to reflect may be an important factor in facilitating binge drinking and thus may help to explain associated alcohol related negative consequences. To date however, few studies have specifically assessed the role of reflection impulsivity in binge drinking and related adverse behavioural consequences amongst young adults.

A potentially serious behavioural consequence of heavy drinking behaviour, which would appear to be related to impulsivity, is an increased likelihood of unplanned sexual behaviour (e.g., Bersamin et al., 2012; Orchowski et al., 2012; Poulin & Graham, 2001). For example, in one study, Bersamin et al. (2012) reported that the number of times University students reported being drunk was positively associated with frequency of sex with strangers. Similarly, studies have found positive associations between drinking and unplanned sex (e.g., Corbin & Fromme, 2002), however, others have reported only inconsistent evidence regarding this relationship (Veles-Blasini, 2008). Interestingly, the available evidence implicates alcohol and sex related beliefs and expectancies as potentially important factors in predicting sexual behaviour following excessive alcohol use (Brown & Vanable, 2009; Orchowski et al., 2012). For example, Orchowski et al. (2012) reported that the belief that alcohol would facilitate 'liquid courage' was significantly associated with 'regretted' sexual behaviour following alcohol use amongst University students. These findings suggest that students who expect alcohol to increase assertiveness are more likely to have engaged in sexual behaviour that is perhaps unplanned and thus later regretted.

However, while there are numerous studies examining alcohol use and 'risky sexual behaviour' (e.g., Brown & Vanable, 2007; Cooper, 2002) few studies have attempted to explore potential explanations for the link between binge drinking and unplanned sexual behaviour. Whilst the decision to engage in risky sexual behaviour can be a purposeful planned action, *unplanned* sexual behaviour resulting from alcohol use is, it can be argued, a

qualitatively different behavioural outcome, probably more closely associated with impulsivity. That is, individuals with high levels of impulsivity who binge drink may be particularly likely to engage in *unintended* sexual behaviour due to a heightened tendency toward 'spur of the moment' behaviour (e.g., non-planning; Whiteside & Lynam, 2001; see also, Eysenck et al., 1987). Reflection impulsivity may be a particularly important variable in this context as a reduced capacity to evaluate all available information effectively may be a critical contributing factor to unintended and unplanned behaviour resulting from excessive alcohol use. However, to date no studies have specifically examined the relationship between reflection impulsivity, binge drinking, expectancies, and unplanned sexual behaviour.

Thus, the purpose of this study was to assess reflection impulsivity, expectancies, and unplanned sexual behaviour in a sample of University students. A sample of 'high-binge' drinkers (median split: > 28.5 on the 'binge drinking score' derived from the Alcohol Use Questionnaire; Mehrabian & Russell, 1978) were compared to a group of 'low-binge' drinkers on a validated behavioural index of reflection impulsivity (IST; Cambridge Cognition Ltd.) and completed self-report measures of alcohol-related expectancies and unplanned sexual behaviour. The hypotheses tested were that, a) high-binge drinkers would display significantly lower levels of reflection as indexed by the IST when compared to low-binge drinkers; b) high-binge drinkers would report significantly higher levels of unplanned sexual behaviour relative to the low-binge drinkers; c) compared to low-binge drinkers, high-binge drinkers would hold significantly more positive expectations regarding the effects of alcohol; and d) drinking behaviour and alcohol-related expectancies (particularly liquid courage) would significantly predict levels of unplanned sexual behaviour and IST-reflection impulsivity.

2. Materials and Methods

2.1 Participants

Ninety five young, healthy volunteers who described themselves as social drinkers answered an advertisement to take part in a study looking at the relationship between drinking patterns, mood, and unplanned sexual behaviour. Volunteers with a history of neurological diseases, drug or alcohol dependence were not included in the study. Self-reported alcohol intake for the previous 24 hours was asked for and participants who had drunk more than 6 drinks on the previous day were excluded. The criteria excluded 3 participants, 2 males and 1 female, leaving a total of 92 participants (43 male and 49 female) between the ages of 18 and 34 (mean 22.3 SD 4.46).

2.2 Measures

2.2.1 Alcohol Use Questionnaire (AUQ)

A quantity-frequency, beverage-specific index of alcohol consumption for the previous 6 months was obtained using a revised version of the Alcohol Use Questionnaire (AUQ; Mehrabian & Russell, 1978). The revised questions, by determining brands of liquor, allow for actual alcoholic content (percentage volume) of drinks to be assessed. Participants were asked to estimate the number of drinking days, the usual quantity consumed and the pattern of drinking. The AUQ has previously been shown to be a reliable measure of drinking quantity and drinking pattern (Townshend & Duka, 2002). *Binge drinking score:* A ‘binge drinking’ score was calculated for all participants on the basis of the information given in items 10, 11 and 12 of the AUQ [Speed of drinking (average drinks per hour); number of times being drunk in the previous 6 months; percentage of times getting drunk when drinking (average)] (Mehrabian & Russell, 1978). For this study two groups were created above and

below the median (28.5) of the binge drinking score (46 'high-binge' scorers, 46 'low-binge' scorers, see Table 1).

2.2.2 Alcohol Expectancy Questionnaire (AEQ)

Based on the Comprehensive Effects of Alcohol Questionnaire (CEOA; Fromme et al, 1993), the AEQ is a 38-item questionnaire, which assesses positive and negative expected effects of alcohol consumption. There are seven expectancy factors, four positive (sociability, tension reduction, liquid courage and sexuality), and three negative (cognitive and behavioral impairments, risk and aggression, and negative self-perception).

2.2.3 Sexual Behavior Questionnaire:

This questionnaire was created specifically for the study and consisted of 16 questions around sexual behavior, decision making, impulsivity and regret. The questions of relevance to this paper were Q1 'Approximately how many times have you ever engaged in unplanned sexual activity with non-partners or strangers?' Possible answers were 'never, once, 2 – 5 occasions, 6 – 10 occasions, 11 or more occasions.' Q12 'Generally, how would you rate yourself as a decision maker?' Answers were on a 5 point scale from 'very bad' to 'very good'. Q13 'Generally, would you describe yourself as an impulsive person?' Answers were on a 5 point scale from 'not at all impulsive' to 'very impulsive'.

2.2.5 Reflection Impulsivity: Information Sampling Task (IST; *CANTAB Cambridge Cognition Ltd.).*

The IST measures reflection impulsivity on two sets of ten trials. Twenty five grey boxes are presented on a 5x5 matrix with two coloured squares displayed beneath. The two squares beneath are of different colours. When respondents touch any of the grey squares they turn to one of the two colours displayed beneath and remain that colour for the duration of each

individual trial so there is no working memory requirement to the task. Participants are asked to decide which colour is in the majority, basing their decision on the boxes revealed.

The IST has 2 conditions, Fixed Win (FW) and Decreasing Win (DW). The first 10 trials are played in the FW condition with a win of 100 points for a correct choice and 100 points deducted for a wrong choice, regardless of the number of boxes opened. In the FW condition subjects are informed that they can open as many boxes as they choose before making their decision. When they are ready to decide their decision is indicated by touching the box beneath which corresponds with their majority colour choice. At this point they are informed whether they have made a correct decision or not and awarded or deducted points accordingly. In the second, DW condition, participants begin with 250 points but their score decreases by 10 points for each box opened. Their score reduces by 100 points for an incorrect choice, regardless of when they make their decision. Performance on the task is measured by the number of boxes opened, the proportion of correct choices, the number of incorrect responses, and the time taken to make a decision.

2.3 Procedure

The study was approved by the University of West London Psychology Ethics Sub-committee. All volunteers gave their informed consent and were compensated for their time with a £10 Amazon voucher. All procedures were conducted in a dedicated research laboratory at the University of West London. Participants completed a brief demographics questionnaire followed by the AEQ. The IST was then completed followed by the AUQ and finally the sexual behaviour questionnaire.

3. Results

3.1 Demographics

Table 1 shows the demographic data for the drinking pattern groups and separately for males and females. The high-binge drinking group drank more units per week [$t(90)=4.90$, $p < 0.001$] and first became drunk at an earlier age [$t(88)=3.31$, $p < 0.001$]. There was also a significant but small difference between the ages of the groups with the low-binge drinking group being slightly older than the high-binge drinkers [$t(90)= 2.65$, $p = 0.01$]. High-binge drinkers smoked more cigarettes and more cannabis than the low-binge drinkers. Age, age of first getting drunk, smoking and cannabis use were entered as covariates where significant differences were found between groups.

[TABLE 1]

3.2 Reflection Impulsivity: Information Sampling Task

A repeated measures MANOVA was conducted for both the fixed and decreasing win condition to examine differences between groups on levels of reflection. There were four DVs (No. of boxes opened; P Correct [proportion correct choices]; total errors; latency) and 2 groups (high-binge and low-binge). Condition (fixed win or decreasing win) was the within subject factor. There was an overall main effect of condition [$F(4,87) = 42.58$, $p < 0.001$, $\eta^2_p = 0.66$] and a significant condition by group interaction [$F(4,87) = 3.02$, $p = 0.02$, $\eta^2_p = 0.12$]. The main effect of group was not significant ($p = 0.11$). Univariate analysis indicated significant interactions between condition and group on number of boxes opened [$F(1, 90) = 11.38$, $p < 0.001$, $\eta^2_p = 0.11$], P Correct [$F(1, 90) = 8.81$, $p = 0.02$, $\eta^2_p = 0.09$], and latency [$F(1, 90) = 7.92$, $p = 0.01$, $\eta^2_p = 0.08$]. Simple effects analysis revealed that in the fixed win condition the high-binge drinking group opened fewer boxes than the low-binge drinkers ($p < 0.001$), scored lower on the mean P Correct ($p = 0.01$) and made more errors ($p = 0.04$).

However, in the decreasing win condition only the mean latency to respond differed between groups, the high-binge drinkers were faster (see Figure 1). This effect was not significant when cannabis use was entered as a covariate. All other effects remained significant after controlling for age, age at first getting drunk, smoking and cannabis use.

[FIGURE 1]

3.3 Alcohol Expectancies

A multivariate analysis of variance (MANOVA) was conducted to examine group differences on the 7 factors of the Alcohol Expectancy Questionnaire. The analysis revealed an overall significant difference between the two drinking groups [$F(7, 84) = 2.23$, $p = 0.04$, $\eta^2_p = 0.16$]. Univariate tests indicated that the high-binge drinkers scored significantly higher on expectations of sociability [$F(1, 90) = 6.79$, $p = 0.01$, $\eta^2_p = 0.07$], liquid courage [$F(1, 90) = 9.72$, $p < .001$, $\eta^2_p = 0.10$], cognitive behavioural impairment [$F(1, 90) = 5.46$, $p = 0.02$, $\eta^2_p = 0.06$], and risk and aggression [$F(1, 90) = 5.81$, $p = 0.02$, $\eta^2_p = 0.06$]. Table 2 provides means and standard deviations for all seven AEQ subscales.

[TABLE 2]

3.4 Unplanned Sexual Behaviour

A one-way MANOVA was conducted to examine differences between the two binge groups on the three questions drawn from the unplanned sexual behaviour scale. The analysis indicated an overall difference between the groups [$F(3, 88) = 12.32$, $p < .001$, $\eta^2_p = 0.30$]. Specifically, when compared to low-binge drinkers ($\underline{M} = 2.13$, $\underline{SD} = 1.13$), the high-binge drinkers ($\underline{M} = 2.98$, $\underline{SD} = 1.13$) reported significantly more frequent unplanned sexual behaviour [$F(1, 90) = 13.03$, $p < 0.001$, $\eta^2_p = 0.13$]. Similarly, high-binge drinkers ($\underline{M} = 3.74$, $\underline{SD} = 1.08$) rated themselves as significantly more impulsive than the low-binge

drinkers (M = 2.61, SD = 1.04) [$F(1, 90) = 25.98$, $\eta^2_p = 0.22$]. There was no significant difference between the groups on ratings of decision making efficacy.

3.5 Associations between binge drinking, impulsivity, alcohol expectancies and unplanned sexual behaviour.

A final series of analyses were conducted to examine the relationships between binge drinking, reflection impulsivity, expectancies and unplanned sexual behaviour. The variables utilised in the following analyses explained the most between group variance (i.e., largest η^2_p) in the preceding group difference tests. Of particular interest is the extent to which levels of binge drinking and alcohol expectancies (i.e., liquid courage) predict performance on the IST and rates of unplanned sexual behaviour. Thus, two hierarchical multiple regression analyses were conducted. The first analysis regressed reflection (IST no. of boxes opened fixed condition) onto binge score (step 1) and liquid courage (step 2). At step 1, binge score was significantly and negatively associated with IST-reflection, accounting for 4.4% of the variability, $R = 0.21$, [$F(1, 90) = 4.19$, $p < 0.05$]. Liquid courage was entered into the analysis at step 2 (AEQ-LC) and accounted for an additional 4.3% of the variance, [$F_{change}(1, 89) = 4.16$, $p < 0.05$].

The second analysis examined the predictive relationship between binge drinking, liquid courage and unplanned sexual behaviour. At step 1, binge score was significantly associated with unplanned sexual behaviour, accounting for 18% of the variability, $R = 0.43$, [$F(1, 90) = 19.97$, $p < 0.05$]. Liquid courage was entered into the analysis at step 2 (AEQ-LC) and accounted for an additional 4.4% of the variance, [$F_{change}(1, 89) = 5.04$, $p < 0.05$]. Beta weights, unstandardised coefficients and squared semi-partial correlations for both analyses are presented in Table 3.

[TABLE 3]

4. Discussion

The results are generally consistent with predictions and indicate that a University sample of heavy binge drinkers demonstrated impairments on a behavioural task measuring the ability to gather and evaluate information during decision-making (i.e., reflection impulsivity). Further, the high-binge drinking group scored significantly higher than low-binge drinkers on specific alcohol-related expectancies and rates of unplanned sexual behaviour but no different on a measure of mood. Interestingly, and consistent with a previous study (Orchowski et al., 2012), expectations of 'liquid courage' (i.e., assertiveness) was a significant positive predictor of unplanned sexual behaviour. Finally, expectations of liquid courage accounted for additional unique variance in IST performance beyond binge drinking levels. Taken together, these findings support previous work by highlighting the problematic nature of the binge pattern of alcohol consumption (e.g., Maurage et al., 2012; Miller et al., 2007). Specifically, binge drinking in this sample was associated with impairments in decision making and impulse control, heightened positive expectations of drinking and elevated levels of unplanned sexual activity.

Indeed, the reflection deficits observed in the high-binge drinking group is consistent with previous work investigating IST performance in dependent drinkers (e.g., Lawrence et al., 2009) and drug users (Clark et al., 2009; Solowij et al., 2012). In this sample, the binge drinkers opened less boxes and made more errors (and lower proportion correct responses) in the fixed win condition when compared to the low group. This finding is consistent with Clark et al. (2006) who reported impaired IST performance in the fixed win condition for current amphetamine and opiate users (see also Solowij et al., 2012). Thus, our findings

suggest that regular social drinkers who engage in repeated binge drinking episodes may be as impaired as regular drug users in terms of the ability to gather and evaluate information during decision making processes. It is possible that this deficit is due to the specific pattern of heavy use followed by withdrawal periods that has been found to adversely affect prefrontal neural systems responsible for decision-making and impulse control in both alcohol and drug users (e.g., Hermans et al., 2012; Jentsch & Taylor, 1999; Maurage et al., 2012).

This impairment in impulse control and decision-making associated with excessive alcohol use (i.e., poor reflection) may manifest in a variety of problematic drinking-related cognitive and behavioural consequences (e.g., Brown & Vanable, 2009). Specifically, the high-binge drinking group was found to report increased levels of expectations that alcohol would facilitate social cohesion, increase risk taking and aggression, increase cognitive/behavioural impairment, and provide liquid courage. A particular behavioural consequence of interest to this study was the relationship between binge drinking and the frequency of unplanned sexual behaviour. Interestingly, both levels of binge drinking and the expectation that alcohol would enhance assertiveness (liquid courage) were significant positive predictors of unplanned sexual behaviour and reduced reflection. Thus, consistent with a previous study examining sexual 'regret' (Orchowski et al., 2009), students who expect that alcohol will increase assertiveness may be more likely to engage in impulsive unplanned sexual behaviour following excessive drinking.

The finding linking alcohol expectancies with poor reflection is consistent with neurobiological evidence indicating that positive expectancies in adolescence are related to deficits in inhibitory neural processing during a go/no go task (Anderson et al., 2005). The authors propose that such neural deficits may facilitate the development of maladaptive positive expectancies and in turn may lead to heavier drinking behaviour (Anderson et al.,

2005). The finding of significantly poorer reflection in the high-binge group is therefore of interest given that this is a sample of young, relatively inexperienced drinkers. Participants with any history of alcoholism were excluded from the study and thus no individuals reported a chronic long-term use pattern characteristic of dependent users. Despite this, our findings suggest that excessive alcohol use, even at an early age is associated with the reduced reflection characteristic of dependent users who suffer from prefrontal neurotoxicity (e.g., Hermans et al., 2012; Jentsch & Taylor, 1999; Maurage et al., 2012). Consequently, impulsive behavioural responses such an unplanned sexual activity resulting from alcohol use may be more likely to occur (see also Solowij et al., 2012). Therefore, these findings add to the growing body of evidence emphasising the deficits in inhibitory control associated with binge drinking in young adults and thus further support the role of early alcohol intervention techniques in emphasising the adverse consequences of alcohol-related impulsive behaviour.

A particular limitation of the findings pertains to the issue of directionality. The results suggest that there is an association between binge drinking, impulsivity and unplanned sexual behaviour but no direction can be inferred. An examination of the literature suggests that heightened impulsivity during adolescence predicts earlier onset of problem drinking behaviour (e.g., McGue, et al., 2001; Tarter et al., 2005). Therefore, high levels of impulsivity might be a common risk factor for both binge drinking and risky sexual behaviour. However, other studies have demonstrated that ongoing consumption has deleterious effects on neural systems responsible for impulse control (e.g., Clark et al., 2009; Jenstch & Taylor, 1999; Maurage et al., 2009). Thus, it is likely that an early predisposition toward impulsive behaviour may render an individual particularly vulnerable to heavy drinking which in turn may serve to further exacerbate impulsive behavioural outcomes.

In summary, this study contributes to the study of impulsivity and alcohol use by demonstrating that unplanned sexual behaviour may be one outcome of binge drinking

behaviour. Thus, individuals who engage in regular binge drinking may have deficits in utilising and evaluating all pieces of information during the decision making process (i.e., poor reflection) and are more likely to report unplanned sexual behaviour. Furthermore, consistent with previous work (Orchowski et al., 2012), heavier binge drinkers expect that the consumption of alcohol will increase assertiveness, and interestingly, this variable (expectations of 'liquid courage') was also predictive of unplanned sexual behaviour. Overall, the findings indicate that heavy binge drinkers demonstrate impairments on an impulse control task similar to that observed in dependent samples and this may be an important factor in understanding the many negative behavioural consequences associated with excessive alcohol use.

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598 Table 1
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Group characteristics	'Low-binge'			'High-binge'		
	Total M (SD)	Males M (SD)	Females M (SD)	Total M (SD)	Males M (SD)	Females M (SD)
Number	46	20	26	46	23	23
Age**	23.57 (5.33)	23 (5.39)	24 (5.34)	21.17 (3.01)	21.57 (3.02)	20.78 (2.97)
Alcohol units[1] per week**	17.19 (12.54)	17.48 (15.76)	16.96 (9.71)	43.13 (33.62)	52.87 (42.26)	33.39 (18.12)
Binge drinking score**	15.04 (7.02)	13.55 (5.48)	16.19 (7.92)	61.24 (32.32)	70.26 (38.18)	52.21 (22.56)
Age of first drink	13.61 (3.04)	12.70 (3.51)	14.31 (2.43)	13.35 (2.70)	13.57 (2.86)	13.13 (2.58)
Age of first time being drunk**	16.20 (1.78)	16.26 (1.82)	16.15 (1.78)	15.04 (1.52)	15.13 (1.71)	14.95 (1.33)
Cigarette smokers** (previous 24hrs) (n)	6	1	5	23	14	9
Regular cannabis** (>3 x per week) (n)	1	0	1	13	11	2

600 [1] One unit is 8 g of alcohol

601 ** $p<0.005$ differences between groups (binge drinkers and non-binge drinkers)

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Table 2.

Alcohol Expectancy Factors	Low-Binge (n=46) M (SD)	High Binge (n=46) M (SD)
Sociability *	27.97 (3.08)	29.48 (2.40)
Tension reduction	8.09 (1.74)	7.89 (1.80)
Liquid courage **	13.46 (2.65)	15.13 (2.50)
Sexuality	10.0 (2.66)	10.89 (2.71)
Cognitive & Behavioural Impairment *	24.96 (4.97)	27.33 (4.76)
Risk and aggression *	12.54 (3.14)	14.02 (2.73)
Negative self perception	7.45 (2.61)	7.85 (2.77)

* $p < 0.05$, ** $p<0.01$

Table 3.

POMS Factors	Low-Binge (n=46) M (SD)	High-Binge (n=46) M (SD)
Anxiety	0.55 (0.57)	0.47 (0.42)
Depression	0.34 (0.62)	0.18 (0.24)
Anger	0.25 (0.54)	0.21 (0.33)
Vigour	1.37 (0.90)	1.38 (0.60)
Fatigue	0.98 (0.73)	0.97 (0.70)
Confused	0.58 (0.57)	0.64 (0.50)

642 Table 4

	ΔR^2	B	*SE*	β	*t*	sr^2
DV: IST-no. of boxes opened						
Step1	0.04*					
Binge score		-0.03	0.02	-0.21	-2.05*	0.04
Step 2	0.04*					
Binge Score		-0.02	0.02	-0.13	-1.20	0.01
Liquid Courage		-0.40	0.20	-0.22	-2.04*	0.04
Overall R^2 = 0.09, *Adjusted* R^2 = 0.07, $F(2, 89) = 4.25$, $p < .05$.						
DV: Unplanned sexual behaviour						
Step 1	0.18**					
Binge score		0.02	0.003	0.43	4.47***	0.18
Step 2	0.04*					
Binge score		0.01	0.004	0.34	3.43**	0.10
Liquid courage		0.10	0.05	0.23	2.25*	0.04
Overall R^2 = 0.23, *Adjusted* R^2 = 0.21, $F(2, 89) = 12.95$, $p < .001$.						

643 *$p < .05$, **$p < .01$, ***$p < .001$.

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Table legends

Table 1. Demographic and alcohol use data for low and high binge groups.

Table 2. Scores on the Alcohol Expectancy Questionnaire for low and high-binge groups.

Table 3. Scores on the Profile of Mood States for low and high binge groups.

Table 4. Binge score and expectations of liquid courage as predictors of IST reflection and unplanned sexual behaviour.

682 **Figure legend**

683 Figure 1. Mean number of boxes opened (a), probability of being correct (b), errors (c) and
684 latency to open (d) for high-binge drinkers and low-binge drinkers across both the fixed-win
685 and decreasing-win conditions. Error bars represent ± SEM.

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