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An eye-tracking study investigating attentional biases for alcohol cues in binge drinkers in a student population

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ABSTRACT

It is well-established that the attention of alcoholics compared with non alcoholics or social drinkers, is captured more by alcohol related than by neutral stimuli. This phenomenon is defined as an attentional bias for alcohol cues. This report focuses on whether attentional bias, commonly found in dependent alcoholics, can be generalised to non-dependent social drinkers.

Binge drinking university students will be compared with non-binge drinkers of the same university population. Participants' eye movements to alcohol-related and control pictures were monitored during a visual probe task where attentional bias was determined from both the eye movement data and latencies in responding to the probe. Questionnaires were also used to examine relations among attention and two general motivation systems.

The results failed to support the hypothesis that binge social drinkers display an enhanced attentional bias towards alcohol related stimuli compared with non-binge social drinkers. Nevertheless, interestingly a significant perceptual direction bias for the left visual field across all participants was found indicating a potential scanning effect. Also, a significant generic slow down of reaction time responses across all groups for alcohol trials indicated a potential emotional Stroop effect. The results show that binge and non-binge sub types of social drinkers may not be as experimentally comparable to other sub categories of social drinking as originally thought. This suggests that research into attentional bias for specific sub groups of social drinkers should be cautious when generalising the findings to all social drinkers.

KEY WORDS:	ATTENTIONAL BIAS	BINGE DRINKING	EYE-TRACKER	VISUAL PROBE TASK	UNIVERSITY STUDENTS

INTRODUCTION

Binge drinking is a topic of increasing media and research interest in the UK. Davey (1997, p.11) has defined binge drinking as "a plan or intent to drink more than the normal to get drunk". Significant numbers of both male and female university students have been found to exceed sensible weekly consumption guidelines. Norman, Bennett and Lewis (1998) noted that 46.3% of all students reported binge drinking at least once per week. Additionally, Delk and Meilman (1996) reported that 62.6% of students had binged in the last fortnight. Consequently, episodes of abstinence from alcohol interspersed with sessions of heavy drinking (e.g. binging) in social drinkers could increase the risk of developing alcohol dependence (Dawson & Archer, 1993). Within the university population where alcohol misuse is widespread, an increased perceptual bias towards alcohol related stimuli may be key determinants in students' choice to become involved in risky drinking behaviour. An individual's attention is drawn to things in the environment which attract or concern them.

Over time, a bias in cognitive processing may develop which guides attention to these stimuli over others. This is known in the literature as an attentional bias. In the topic of addiction, with repeated use of a substance and the development of dependence, attention is selectively drawn to things associated with that substance.

According to Williams, Watts, Macleod and Matthews (1988) attentional bias is "a process in which people are aware of something novel, threatening or related to their current concern" (p.71). It is well established that the attention of alcoholics compared with non-alcoholics, or social drinkers, is captured more by alcohol-related than neutral stimuli (Cox, Blount & Rozak, 2000). This phenomenon is thought to develop through implicit learning from direct and indirect drinking experiences (Ames, Franken & Coronges, 2006). This attentional bias can be seen throughout a range of anxiety related disorders. For instance, patients who have a spider phobia show an attentional bias towards cues of spiders (Lavy & Van den Hout, 1993), social phobic's direct their attention towards threatening faces (Mogg, Philippot & Bradley, 2004) and individuals with generalised anxiety disorder demonstrate an attentional bias in the direction of general threatening information (Hayes & Hirsch, 2007).

However, attentional biases are not just limited to individuals with an anxiety disorder. For instance, depressed groups have been found to have attentional bias to depressive information, (Erickson et al., 2005; Koster, De Raedt, Goeleven, Franck & Crombez, 2005) and chronic pain patients also demonstrate a cognitive bias towards pain related information (Dehghani, Sharpe & Nicholas, 2004). Mogg, Bradley, Hyare and Lee (1998) reported that attentional biases were not exclusive to psychological and emotional states; their findings established selective attention towards food related stimuli in hungry participants. Evidence for an attentional bias has also been reported for addictive behaviour and drug-related stimuli. More specifically, these have been found in methadone maintained opiate addicts (Lubman et al., 2000), smokers (Gross, Jarvik & Rossenblatt, 1993; Waters & Feyerabend, 2000; Ehrman et al., 2002 ; Bradley, Mogg, Wright & Field, 2003), crack cocaine users (Rosse et al., 1997) and gamblers (McCusker & Gettings, 1997).

A considerable amount of research has also explored the idea of attentional bias with alcohol dependent individuals. Alcohol related attentional bias is thought to be highly influential in causing alcoholics to maintain and return to drinking even when they are aware of the negative consequences of the behaviour (Cox, Hogan, Kristian & Race, 2002). It has been suggested that an alcohol attentional bias causes alcohol related objects to be more salient than they would be otherwise and as a result they capture

attention more, enter consciousness more and therefore, impact on drinking decisions and influence the individual to consume more alcohol (Cox, Fadardi & Pothos, 2006). Using cognitive paradigms the presence of such a bias has been shown when participants respond more favourably towards alcohol-related stimuli than neutral stimuli. In numerous studies alcohol dependent individuals have shown an attentional bias towards alcohol related stimuli (Bauer & Cox, 1998; Cox et al., 2000; Johnsen et al., 1994; Sharma, Albery & Cook, 2001; Stetter, Ackermann, Bizer, Straube, & Mann, 1995). Conversely, there have been studies which have reported the opposite, that alcohol dependent inpatients going through treatment demonstrate a significant attentional avoidance of alcohol related cues (Noel et al., 2006; Stormark, Field, Hugdhal & Horowitz, 1997). However, once patients are out of treatment the conscious strategic allocation of attention towards potential cues has been suggested to guide dependent users into relapse. Sayette et al., (1994) showed that alcohol cues interfere with alcoholics' abilities to pay attention to other stimuli. This disruption of attention may reduce one's ability to attend to the use of coping skills.

The main question at hand is whether this alcohol attentional bias so readily found amongst alcohol dependent participants can be generalised to non-dependent drinkers. Until recently, alcohol attentional bias has been assumed to be present in alcohol abusers and problem drinkers but not in social drinkers. However, more recently studies have suggested that an alcohol attentional bias may occur in not only alcohol dependent individuals but also in some social drinkers, but that in social drinkers it is at a diminished level (Townshend & Duka, 2001). Furthermore, as alcohol attentional bias is thought to arise as a result of implicit learning through both direct and indirect experiences and so increases as the level of consumption increases, then it might be envisaged that an alcohol attentional bias would occur within social drinkers and that it may even vary with the level of habitual social drinking. Research into attentional bias to alcohol stimuli in social drinkers have been both limited in number and inconsistent in their findings.

Townshend and Duka (2001) found that heavy social drinkers demonstrated an attentional bias towards the alcohol related cues when compared to the occasional social drinkers. This was also supported by work from Field, Mogg, Zettler and Bradley (2004) who found comparable findings that when compared to light social drinkers, heavy social drinkers displayed an attentional bias for alcohol stimuli. However, this finding is not consistent across all research. A lack of attentional bias for alcohol related cues in comparison with neutral cues for both light and heavy alcohol drinkers has been reported (Johnson et al., 1994; Stetter et al., 1995), suggesting that cognitive processes that underlie selective attention in experimental paradigms may not be adequately developed for non-dependent social drinkers. Regardless of whether an attentional bias for social episodic drinkers may be subtle, this group of drinkers may provide a key indication in understanding the underlying features associated to the development of problem drinking. As a result, any common factors that are established to be related to variations in attentional bias in this particularly high risk group could eventually lead to meaningful targets of intervention (Ceballos, Komogortsev, & Turner, 2009).

A specific model of cognitive biases in addiction has not yet been formed (McCusker, 2001). Initially models which theorised about the role of stimuli in continued drug use were based on simple conceptualisations of the conditioning theory (Wikler, 1948; Stewart, de Wit & Eikelboom, 1984). Since then, attempts to inhibit the conditioning process and prevent further drug use have been largely unsuccessful (Niaura, 2000).

Therefore, this implies that the process of conditioning is not the sole motivating factor in the association between drug-related cues and continued drug use or relapse. Theories have since advanced to incorporate knowledge from neurobiology (e.g. Robinson & Berridge, 1993) and cognitive psychology (Tiffany, 1990). Robinson and Berridge (1993) posit that repeated use of potentially addictive substances leads to a change in the dopamine systems. These neurological changes lead to an increase in the incentive value of the substance at hand which enters cognitive processing as craving. Whenever the substance is encountered classical conditioning processes will cause the stimuli in the environment to become associated to this excess dopamine activity giving rise to learned incentive properties.

A cue with high levels of incentive salience attracts attention and such attention attraction characterises attentional bias (Robinson & Berridge, 1993). The automatic regulation of drug seeking behaviour is suggested by the cognitive processing model (Tiffany, 1990). Tiffany suggests that over time drug seeking behaviours become a stereotypical automatic sequence - this is because they were repeated consistently and so are thoroughly learned. This is done through conscious development of schema or plans that are learned through practice. Through practice they can be instantiated without awareness and carried to completion with a lack of awareness, which is a hallmark of addiction (Tiffany, 1990). Each of the models discussed proposes a mechanism in which cues associated with specific drug use capture attention and guide behaviour towards drug seeking and consumption. They both make similar assumptions, nevertheless, they might be best thought of as frameworks rather than isolated precise theories.

Experimental methods that test the cognitive processes based on the behavioural responses to addiction related cues appear to be the most effective procedure of measuring attentional bias (McCusker, 2001). Earlier research implemented the modified versions of the colour naming Stroop task in order to show the presence of an attentional bias toward stimuli associated with the dependence. More specifically, an attentional bias was shown in problem drinkers and nicotine smokers (Gross, et al., 1993; Johnsen et al., 1994; Sharma et al., 2001). However, it has been argued that the Stroop effect may be due to a difference in the process of selecting and generating a response (Macleod, 1991), as opposed to being a result of attentional bias. Later research has used the visual probe task to overcome this difficulty. The visual probe task has been used in previous research to detect attentional bias in nicotine smokers (Bradley, Garner, Hudson & Mogg, 2007; Mogg, Field & Bradley, 2005), opiate addicts (Lubman et al., 2000) and heavy but not light social drinkers (Townshend & Duka, 2001).

Typically, the instructed task is to quickly detect the appearance of the target stimuli and its location. Immediately prior to displaying the stimuli, a pair of distracter cues is momentarily and simultaneously presented. Of this pair, the semantic content of one of the stimuli is alcohol-related and the semantic content of the other is neutral. For an attentional bias to become apparent, it is calculated that reaction times to the target stimulus when it is in the location from which the alcohol-related cue disappears will be quicker as compared with the reaction times when the target stimulus replaces a neutral distracter cue. From this difference, it is inferred that attention had already been directed towards the alcohol related location rather than the neutral location. In a later study, also using the visual probe task, Field, Mogg, Zetteler and Bradley (2004) investigated both initial orienting and maintained attention for alcohol related stimuli within social drinkers. This revealed an alcohol

attentional bias in the heavier drinkers when distracter cues were presented for 500 milliseconds (ms) and 2,000ms but not when cues were presented for 200ms suggesting that there is no initial orientation bias, but consistent with Townshend and Duka (2001), a bias exists at longer time periods. It is important to be aware, however, that these behavioural tasks do not offer the most direct measure of selective attention; it is not rational to suggest an absolute association between task performance and the allocation of selective attention. Notably, more direct measures of visuospatial attention have been made available. Specifically, eye movement tracking provides an unambiguous indicator of overt attention.

Research from a range of domains show that there is a close relationship between the attentional and occulomotor systems (Smith, Jackson & Rorden, 2009). Although the same research has shown that *covert attention* might be shifted to a particular area of interest before an eye movement is made (Kowler, 1995), it has been noted that an eye-movement will typically come shortly after this. This behaviour has been described as representing *overt attention* (Deubel & Schneider, 1996). Therefore, eye-movements do not represent attention in isolation, but they are excellent indicators that have been used to gain a better understanding of alcohol attentional bias. Although research into the use of eye movements in attentional bias for alcohol related cues is still in its infancy, they have been widely used in conjunction with behavioural paradigms in studies of attentional bias with smokers (Mogg, Field & Bradley, 2005) and cannabis users (Field, Eastwood, Bradley & Mogg, 2006). To date, only one study has been found to show an alcohol attentional bias by the procedural means of eye movement monitoring with the visual probe task. Schoenmakers, Wiers and Field (2008) investigated heavy social drinkers who received an alcohol prime dose or a placebo drink. They found that after the prime dose of alcohol, individuals demonstrated higher reports of craving and as a result, increased levels of attentional bias. This study, however, fails to distinguish between different sub-types of social drinkers, which the current study aims to elaborate on.

The current research will use the visual probe task and measure both reaction times and eye movements to assess attentional bias for alcohol cues in binge and non-binge social drinkers.

Eye movements will be monitored throughout the visual probe task for the reason that it will offer an additional, and arguably more direct, measure of attention to the behaviour recordings of response latencies. The research will elaborate on findings from Townshend and Duka (2001) who found indices of alcohol attentional bias for heavy social drinkers and not light social drinkers. The study will explore if these findings can be generalised to binge and non-binge sub-types of social drinkers. Townshend and Duka (2001) limited their experimental design to just RT measures with the visual probe task in order to explore attentional bias for alcohol cues. The current investigation will measure eye movement, during a visual probe task, which will measure the maintenance or delayed disengagement of attention, as well as the initial orientating of attention. The BIS/BAS scale of personality (Carver & White, 1994) will be used to see if comparable results can be found with those of Weissenborn and Duka (2003), who showed that binge drinkers who fall into a moderate to heavy social drinking band have noticeably higher scores in 'novelty seeking' personality traits compared with those who do not binge. The main aim of this study is to explore whether a group of non-dependent binge social drinkers would differ in their selective attention towards alcohol-associated cues in comparison with a group of non-binge social alcohol drinkers. The hypothesis, consistent with findings by Townshend and Duka (2001), is that binge drinkers,

similar to heavy social drinkers, would have an enhanced attentional bias for alcohol-associated stimuli, compared to non-binge drinkers or light social drinkers. With use of the BIS/BAS questionnaire (Carver & White, 1994), individual differences of measures for two motivational systems that underlie behaviour – approach (to regulate appetitive motives) and avoidance (to regulate aversive motives) — will assess whether trait differences correlate with binge and non-binge drinking behaviour.

METHODS

Participants
Forty-two participants (4 males, 38 females) were recruited from the student population at Roehampton University, via recruitment on SONA (an online experiment management system) and poster advertisements put up around the Department of Psychology. All participants who took part were undergraduate psychology students who received course credit for taking part in the study. The mean age of participants was 22.95 years (SD = 7.36). To be able to take part, participants had to have normal or corrected to normal vision. All participants gave their informed consent before commencing with the study, which had been fully approved by the Roehampton University ethics committee.

Visual Probe Task
1. Stimulus Materials

1.1. Pictures: The pictorial stimuli used in the visual probe task consisted of ten alcohol-related pictures which were matched with ten neutral pictures of ordinary household objects. Examples of the alcohol pictures included a bottle of whiskey, a bottle of wine with a full glass, bottles and drinks of beer and spirits. The household objects were matched as far as possible for complexity of the picture design and also for content but lacking any alcohol-related cues. For example, a picture of a hand holding a pint of beer was paired with a picture of a hand holding a stapler. In addition, twelve picture pairs which were not related to alcohol were prepared to be used as practice and filler stimuli in the computer task. Each picture pair (i.e. alcohol-neutral and neutral-neutral) was presented twice, swapping the pictures in each pair so that they both appeared on the left and right side of the screen, making a total of forty-four presentations of picture pairs. The first four trials were neutral-neutral practice buffer trials. The forty remaining alcohol-neutral and neutral-neutral trials were randomly interspersed and were presented in a new random order for each participant. All pictures were presented in black and white and were presented on a black background. All pictures were resized to the same size, enclosed within an 11cm (width) x 14cm (height) frame.

2. Procedure
Participants were seated in front of the computer monitor and were asked to read through the instructions displayed on the screen. They were informed that their reaction times would be recorded and were told to look at the fixation cross when it appeared in the centre of the screen. Each trial started with a central fixation cross shown for 500ms, which was replaced by the display of a pair of pictures, side by side for 3000ms. The inside edges of the picture frames were positioned 2.5cm from the left and right of the fixation point. Immediately after the picture offset, an arrow

was presented in the position of one of the preceding pictures, until the participant made a response. The target arrow was 0.8cm in height and appeared 4.5cm from the centre fixation. There was an inter-trial interval of 1000ms. The participants were instructed to respond as accurately and as quickly as possible using one of the two keyboard response keys, either the number one key if the target arrow was pointing upwards or the number two key if the arrow was pointing downwards. At the start of the task, the participants were given four practice trials. The visual display and response collection was controlled by E-prime software, which recorded the participant's response accuracy and reaction times for each trial. The dependent variables in this task were reaction time in ms to press the response key for the target arrow, the percentage accuracy and the four eye gaze direction measures from the eye movement data.

Design and Approach to Data Analyses
1. Visual probe data
During the visual probe task, both accuracy and reaction times for each participant were recorded. These two measures were the dependent variables for the visual probe task. The independent variables were the trial type (alcohol-neutral (A-N), neutral-alcohol (N-A) and neutral-neutral (N-N)), target location (left and right) and experimental group (binge drinker and non-binge drinker). An attentional bias score was calculated for each participant by taking away the mean response time (in ms) when the target arrow was in the same position as the alcohol associated cue from the mean response time (in ms) when the target arrow and the alcohol associated cue were in different positions (Lubman et al., 2000). Analyses of variance were used as a statistical method to explore any main effects and interactions between the independent variables for the recordings of accuracy and reaction times. A two-way ANOVA was conducted for both measurements of the visual probe task using a mixed 2 x 3 x 2 design, with the between subjects variable as the experimental group (2 levels; binger vs. non-binger) and the within subject variables as trial type (3 levels; A-N, N-A and N-N) and target location (2 levels; left and right). A correlation test was also performed for the attentional bias scores and the BIS/BAS measures on the personality questionnaire.

2. Eye movement data
The eye tracking equipment recorded four measurements of the participants' eye gaze. These were time to first fixation, duration of first fixation, overall fixation length and overall fixation count. These four measures were the dependent variables for the eye movement data. The independent variables were the trial type (alcohol-neutral vs. neutral-alcohol; in other words the location of the alcohol picture is on the left or right), gaze direction (towards left or right picture) and experimental group (binger or non-binger). All data sets were analysed using a mixed design 2 x 2 x 2 ANOVA, with the experimental group as the between-subject factor, and trial type and gaze direction as the two within-subject factors. A further measure that was derived from the eye-tracker data was 'gaze direction bias'. Gaze direction figures which signified the initial orientation of attention were formulated by computing the number of trials where the first fixation was directed towards the alcohol picture as a proportion of all trials where the first fixation was made to either picture. Initial gaze fixations which were not directed to either picture or if the initial gaze fixation occurred <0.1ms were not used in the statistical analysis of direction bias.

Eye Tracking

Eye-movement data was analysed using the eye tracker software (Tobii Studio). Eye movements throughout the visual probe task were computed to the regions of the screen that correspond to those occupied by alcohol and control pictures, and the centre region. Participants' eye movements were recorded using a 120 Hz video-based infrared eye tracking camera (Tobii T120, Tobii Systems). The T120 eye tracking camera was non-invasive, unobtrusive, and completely safe. Picture pair stimuli were presented on a 20" monitor, using Tobii Studio and E-Prime software, and the camera with an infrared source was placed underneath the monitor of the stimulus PC. The camera captured participants' eye movements through tracking the centre of the pupil and the corneal reflection, and the connected PC running Studio software digitally stored participants' gaze for further analysis. Data from practice trials were discarded.

Questionnaires

Before the experimental task, participants were given the following questionnaires to complete, and together with these questionnaires participants were also given a letter of invitation, consent form and debrief form.

1. Population Characteristics

Demographic data was established from information gathered from the participants and included age, gender, ethnicity and education information.

2. Alcohol Use Questionnaire (AUQ)

A quantity frequency, beverage specific indicator of alcohol consumption for the previous six months was gathered using a revised version of the Alcohol Use Questionnaire (AUQ: Mehrabian & Russell, 1978). The questionnaire is set out to give an accurate approximation of individuals' average alcohol intake. As well as quantity of alcohol consumed, other items in the questionnaire look more specifically at speed of drinking (number of drinks consumed per hour) (item 10), number of times drunk by alcohol within the previous six months (item 11) and percentage of times drunk out of the times going out drinking (item 12). These items on the questionnaire formulate the binge score.

2.1 Binge Drinking Score

A 'binge drinking' score was formulated for all participants on the basis of the answers given in questionnaire items 10, 11 and 12 of the AUQ (Mehrabian and Russell, 1978). The binge score is calculated using the following equation: *[4x (Item 10) +Item 11+0.2x(Item 12)]*. This score suggests the drinking pattern of the participant rather than just an indication of alcohol intake. An example of a typical binge drinker who would produce a binge score of 24 is someone who would typically drink two drinks within an hour (a drink is a glass of wine, a pint of beer, or a shot of spirits straight or mixed), had been 'drunk' six times within the last six months, and would drink to get drunk on 50% of occasions. On the other hand, an example of a non-binger who would attain a binge score of 16 is someone who would typically drink one drink in an hour, had been drunk on four sittings in the last six months, and would drink to get drunk on 40% of occasions. Participants were divided into groups on the basis of their binge score - if their binge score was ≥24 the participant was put in the 'binger' group, and if their binge score was ≤16 the participant was put in the

'non-binger' group (Townshend and Duka, 2005). Participants with binge scores between 16 and 24 were excluded from the statistical analysis.

3. BIS/BAS Questionnaire

Carver and White's (1994) behaviour inhibition and approach system (BIS/BAS) was designed to assess dominance of the BIS and BAS. The scales are based on empirical evidence from Gray's BIS/BAS personality theory which perceives behaviour and affect as the outcome of two general motivational systems: a behaviour inhibition system (BIS) and a behavioural activation system (BAS). From the 24-item questionnaire, scores for the 13 item BAS scale and 7 item BIS scale were determined following Carver and White (i.e. Summing 4-point Likert scale responses). The BIS scale taps one's sensitivity to punishment, and the BAS scale is an index of one's sensitivity to reward drive, fun seeking and reward responsiveness. Carver and White's scales have shown good convergence and divergence validity with other scales.

RESULTS

1. Group Characteristics

A total of forty-two participants completed the study. However, due to recording failure of the eye tracker equipment eye gaze information was not gathered for six participants. Therefore, data could not be interpreted for their eye-movements and so the participants' corresponding visual-probe reaction time data was also excluded from statistical analysis and the correlations with BIS/BAS scales of personality. In order to test the hypotheses, the remaining thirty-six participants were allocated to the "binger" or "non-binger" group based on their overall binge score; a divide was based on guidelines from Mehrabian and Russell (1978). Twelve participants fell into the binger condition and 17 participants were assigned to the non-binger group. The 7 participants with moderate binge scores were excluded from any group comparisons. Table 1 shows summary data for binge and non-binge drinkers. The two groups contained different numbers of males and females, predominantly females across both conditions (binge drinkers=2 males, 10 females; non-binge drinkers=2 males, 15 females). The BIS/BAS questionnaire yielded no significant differences for the motivational systems between the two experimental groups using independent t-tests. Independent t-tests were also carried out to explore group differences for age, AUQ and binge scores. As shown in *Table 1*, the groups did not show a significant discrepancy for age ($t(27) = -1.43$, $p > 0.1$). However, the groups differed significantly on all measures of alcohol/binge scores. Coherent with guidelines from Mehrabian and Russell (1978), binge drinkers had significantly higher binge and Alcohol Use Questionnaire scores than the non-binge group.

Table 1
Characteristics of binge and non-binge drinker groups

	Binge Drinkers (N=12)		Non-Binge Drinkers (N=17)			
	Mean	SD.	Mean	SD.	t(27)	p-value

Age (years)	20.67	2.15	24.53	9.15	-1.43	NS
Alcohol Use Questionnaire	43.04	14.61	11.94	10.10	6.79**	⬚ 0.001
Binge Score	32.42	11.84	6.75	5.87	7.73**	⬚0.001
BIS	23.33	3.58	22.24	3.27	0.86	NS
BAS – Drive	11.75	2.42	11.82	1.81	-0.94	NS
BAS – Fun Seeking	12.17	2.44	11.94	2.11	0.27	NS
BAS – Reward Response	17.83	1.70	17.94	2.19	-0.14	NS

** Significant at the 0.01 level (2-tailed).

2. Visual Probe Task – Behavioural Data
2.1 Accuracy Data

Data was analysed using a mixed design 2 x 2 x 3 ANOVA, with a between-subjects factor of experimental group (binge vs. non-binge), and within-subjects factors were the location of the target arrow (left vs. right), and Trial Type (alcohol-neutral vs. neutral-alcohol vs. neutral-neutral) in other words, for Trial Type, the alcohol picture was presented on the left, right or not at all. For accuracy, Mauchly's test of sphericity confirmed homogeneity of covariance and therefore, sphericity could be assumed ($p = 0.19$). ANOVA revealed a significant main effect for trial type ($F(2, 54) = 3.18$, $p = 0.05$) as accuracy was generally higher for pairs containing alcohol images compared with pairs containing only neutral images. There was also a significant interaction between trial type and target arrow location ($F(2, 54) = 3.56$, $p = 0.04$). Paired samples t-tests revealed a significantly more accurate response percentage in the neutral-alcohol condition where an alcohol picture was presented on the right and when the target arrow on the right replaced the picture, $t(27) = -2.05$, $p = 0.05$, indicating that for both binge and non-binge groups there was an attentional bias for the alcohol picture when displayed on the right side of the screen (see *Figure 1*). This effect was not found when the alcohol picture was presented on the left side of the screen, ($t(27) = 0.57$, $p = 0.57$) and there was no attentional bias to the left or right for neutral trials ($t(27) = 0.95$, $p = 0.35$). Notably, there were also non significant effects found for the main effect of experimental group ($F(1, 27) = 1.48$, $p = 0.23$).
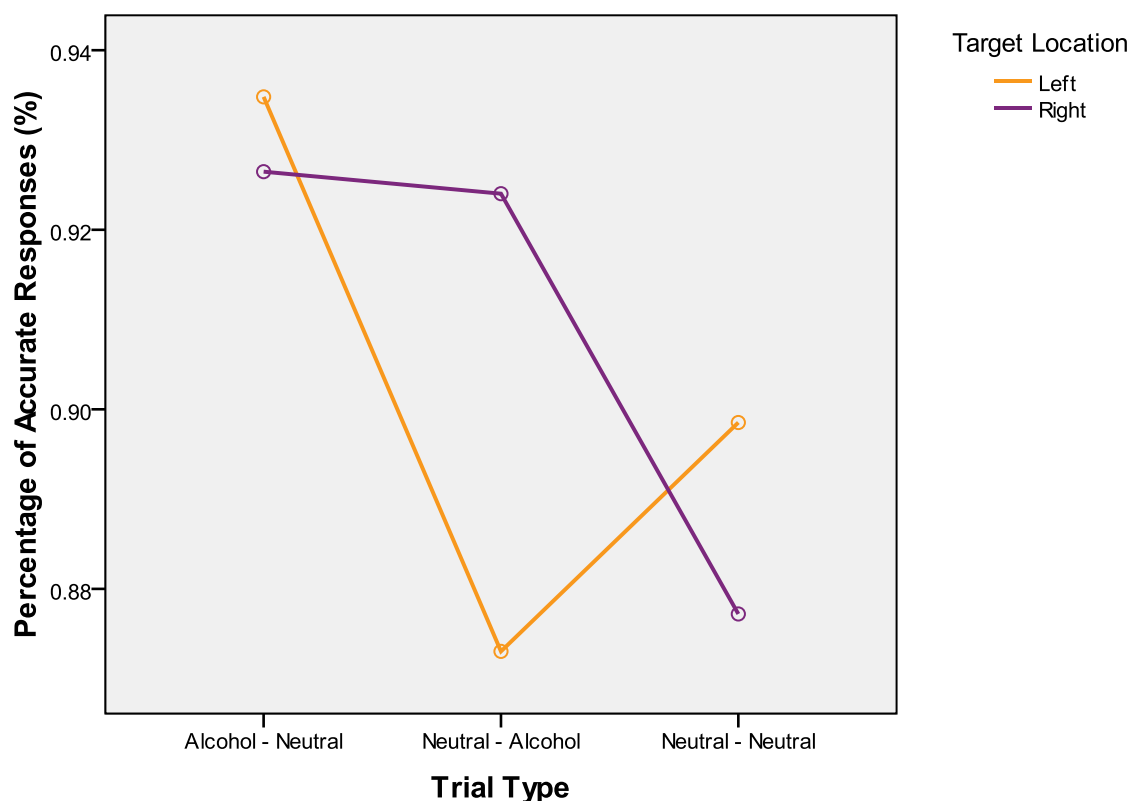
Figure 1: The mean percentage of accurate responses to the target arrow presented in the visual probe task for both experimental groups, shown separately for when the alcohol cue was presented on the left, right and not at all.

2.2 Reaction Time Data

For the reaction time data, Mauchly's test of sphericity confirmed the assumption of homogeneity of covariance therefore, sphericity could be accepted ($p = 0.34$). ANOVA revealed a significant main effect for trial type ($F(2,54) = 4.98$, $p = 0.01$) indicating that for both experimental groups reaction times were more delayed in the alcohol trials (i.e. alcohol-neutral M = 1030.05, SD = 44.05, neutral-alcohol M = 1055.37, SD = 54.77) in comparison to the neutral-neutral filler trials (M = 972.64, SD = 39.71), suggesting a generic slow down of responses when an alcohol picture is displayed. A significant interaction between target arrow and experimental group (bingers and non-bingers) ($F(1,27) = 6.74$, $p = 0.02$) was also found. This suggests that bingers for all alcohol and neutral trials had significantly quicker reaction times when the target arrow was presented on the right side of the screen (M = 1000.09, SD = 69.96), than for non-bingers who displayed much slower reaction times (M = 1045.30, SD = 58.78). Conversely, non-bingers revealed quicker reaction times when the arrow was presented on the left side of the screen (M = 996.31, SD = 56.21) than bingers who displayed much more delayed reaction times (M = 1035.71, SD = 66.91) (see *Figure 2)*. This would suggest that binge drinkers generally have a right-side bias when looking at a screen presenting two images, whereas non-bingers have a left-side bias.
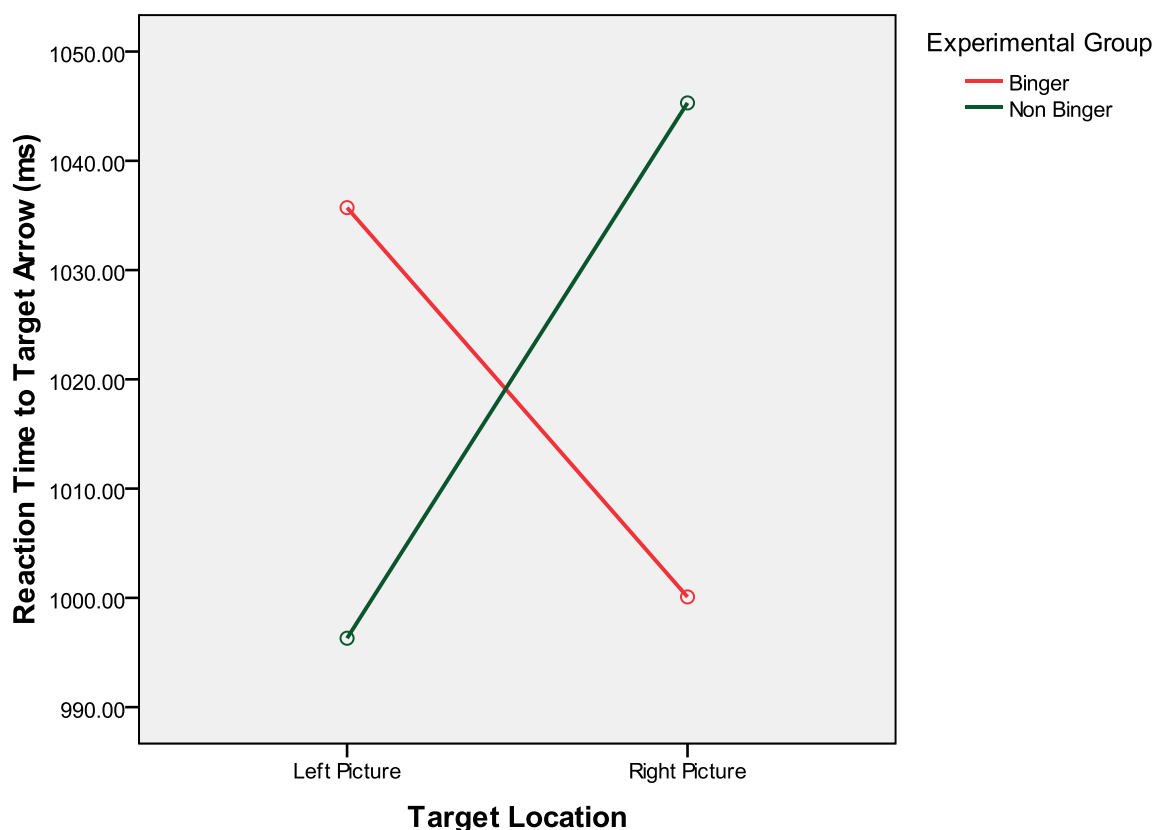
Figure 2: The mean reaction time for responses to the target arrow presented on the left and right side in the visual probe task across all trial types, shown separately for the binge drinking and non-binge drinking groups.

Table 2
A table to show correlations between attentional bias for reaction time data across all measures of the BIS/BAS questionnaire and binge and AUQ scores.

| | Indices of Attentional Bias | |
	r(27)	*p-value*
Alcohol Use Questionnaire	0.20	NS
Binge Score	0.23	NS
BIS	-0.003	NS
BAS – Drive	-0.16	NS
BAS – Fun Seeking	-0.07	NS
BAS – Reward Response	-0.03	NS

Reaction time indices of attentional bias were calculated using the following equation:
((Neutral-Alcohol trial, target left – Neutral-Alcohol trial, target right) + (Alcohol-Neutral trial, target right – Alcohol-Neutral trial, target left)) / 2

These indices of attentional bias were then correlated with all measures of the BIS/BAS questionnaire and AUQ and binge scores (see *Table 2)*. No significant effects were found.

3. Visual Probe Task - Eye Movement Data
Compared with the behavioural data (see above), conflicting results emerge from the analysis of the eye movement data. Analysis of variance was used to look specifically at four components (i.e. dependent measures) of eye movement data. All data was analysed using a mixed design 2 x 2 x 2 ANOVA with the trial type (alcohol-neutral vs. neutral-alcohol; in other words the location of the alcohol picture is on the left or right) and image side (towards left or right picture) as the two within-subjects factors, and experimental group (binger or non-binger) as the between-subjects factor.

3.1 Time to initial fixation
Analysis was carried out for data derived from the eye tracker for the time taken to first fixation. The main effect for image side was significant ($F(1, 24) = 12.58$, $p = 0.002$) implying that there was a significant difference between times taken to look at either the left or right picture independent of where the alcohol picture was or whether the group was binge or non-binge drinkers (see *Figure 3*). More specifically, participants were quicker in both trial types where the alcohol or neutral pictures (M = 0.63, SD = 0.03) appeared on the left compared with the right side where there was a much more delayed time to first fixation for the alcohol or neutral pictures (M = 0.71, SD = 0.02). This main effect was qualified by a significant image side x trial type

interaction ($F(1,24) = 4.20$, $p = 0.05$). Paired samples t-tests revealed that when the alcohol picture was presented on the left there was a significant quicker time to initial fixation towards the alcohol cue ($t(37) = -6.20$, $p < 0.001$) compared with the time taken to look initially at the neutral cue in the pair. Conversely, in trials where the alcohol picture was presented on the right participants took a significantly shorter time to direct initial fixation towards the neutral cue in comparison to the alcohol cue ($t(33) = -2.35$, $p = 0.03$). This implies that there was a bias towards alcohol cues across all groups when these cues appeared in the left location. However, this bias was not apparent (and was even reversed) when alcohol cues appeared on the right.
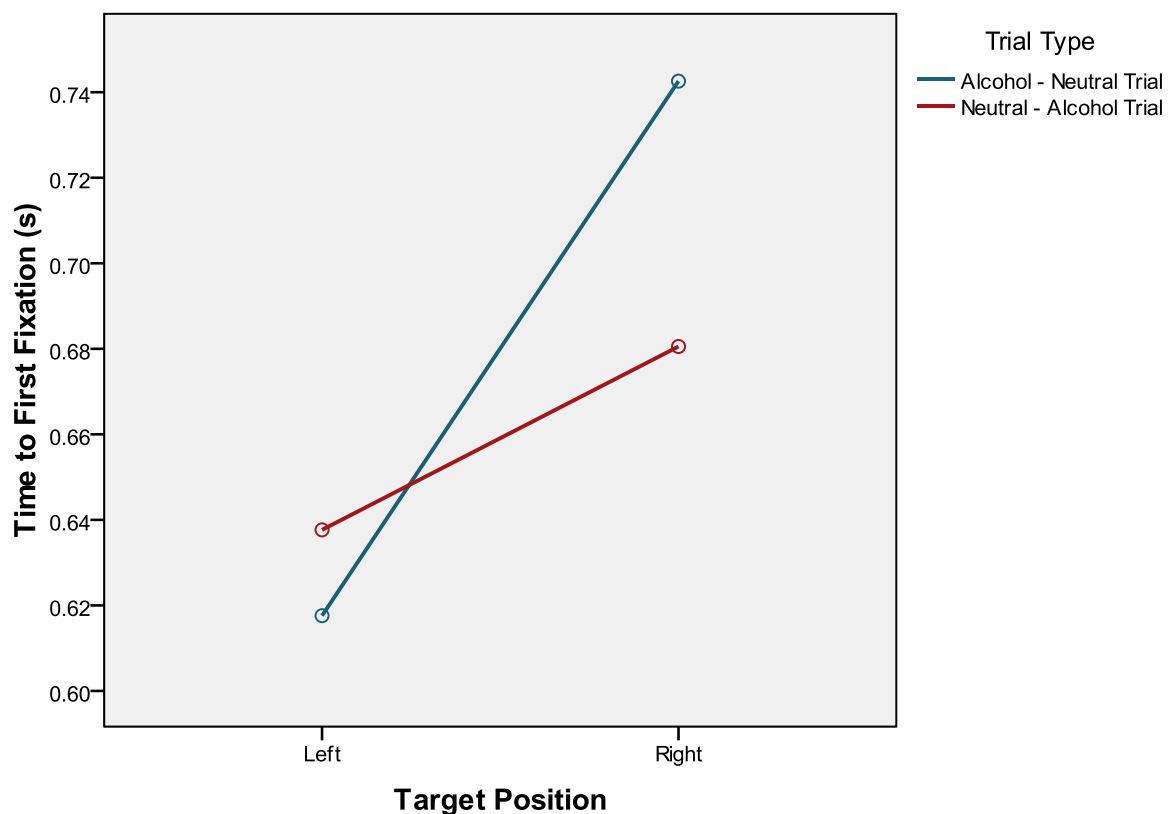

Figure 3: The mean time to first fixation in seconds to the left or right picture in each trial type across both experimental groups (binge and non-binge drinkers), shown separately for each trial type when the alcohol picture is presented on the left side and the right side.

3.2 Duration of first fixation
Analyses were conducted on the data from the eye tracker for the duration of the initial fixation. This showed a significant image side x trial type interaction ($F(1,22) = 6.16$, $p = 0.02$). This is interpreted as when participants initially looked at an alcohol picture they held their gaze for longer when the picture was presented on the left (M = 0.29, SD = 0.02) and the right (M = 0.28, SD = 0.02) as compared with the duration of gaze towards neutral pictures. Here, there was minimal difference of how long they held their gaze on the left (M = 0.26, SD = 0.01) and on the right (M = 0.26, SD = 0.02). The interaction reveals that the duration of first fixation was longer when it was towards the alcohol cue as compared with the neutral cue. From the figure, it would appear that this effect was more pronounced when the alcohol cue appeared on the

left (see *Figure 4*). Paired t-tests revealed that when the alcohol picture was presented on the left there was an effect approaching significance that implied participants looked longer when initially fixating on an alcohol picture than the neutral picture (t(25) = 1.85, p = 0.08). However, when the alcohol cue was displayed on the right there was no such significant effect (t(25) = -0.34, p = 0.74), although there was a numerical trend for participants to look for longer towards the alcohol cue.
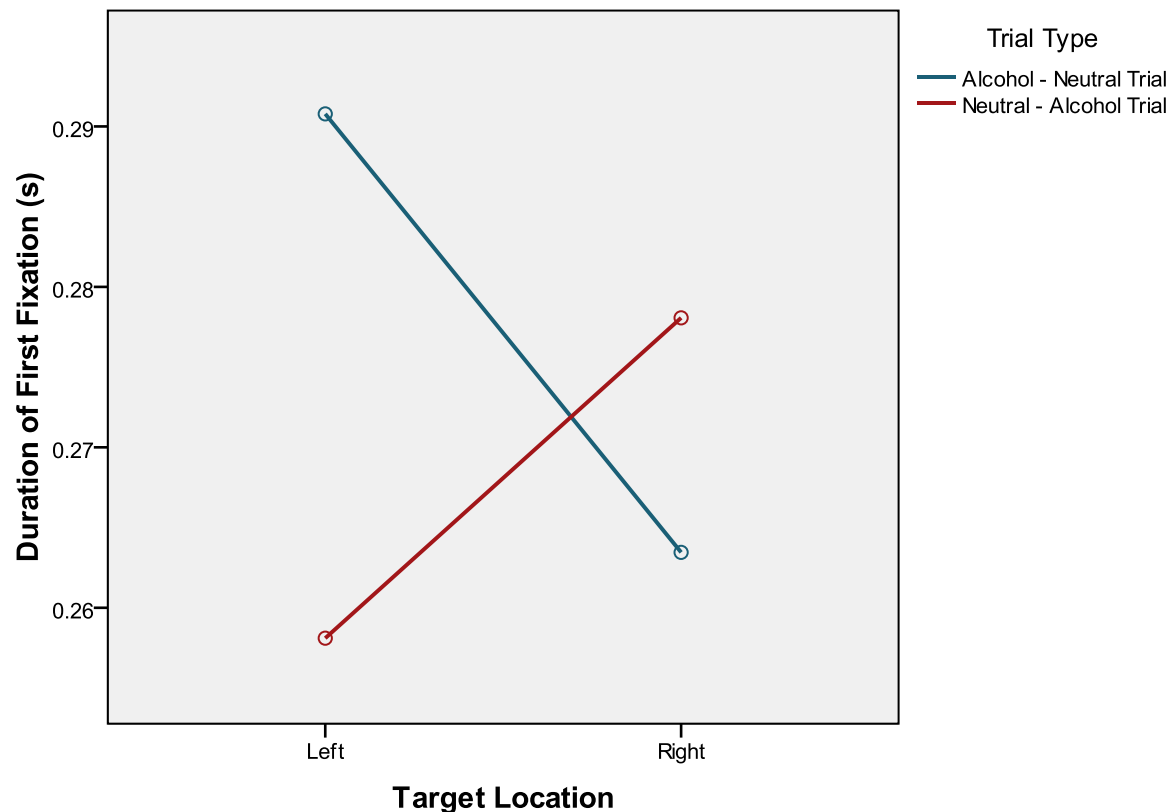

Figure 4: The mean duration of first fixation in seconds to either the left or right picture in each trial type across both experimental groups (binge and non-binge drinkers), shown separately for the trials where the alcohol picture is presented on the left and the right.

3.3 Overall fixation length

Comparable results to the previous measurement of the eye movement data emerge. Analyses showed a significant main effect for image side (F(1,22) = 5.09, p = 0.03) suggesting that participants generally looked for longer at the left picture than the right. Moreover, an image side x trial type interaction was significant (F(1,22) = 6.90, p = 0.02) (see *Figure 5*). Specifically, paired samples t-tests reveal that participants fixated on the alcohol picture for longer when it was presented on the left (t(31) = 4.38, p < 0.001). However, when the alcohol picture was presented on the right there was a non-significant difference between whether the participant looked at the alcohol picture or the neutral picture in the pair (t(34) = 1.85, p = NS), although the figure reveals a trend for looking towards the alcohol picture. This implies that when the alcohol picture is presented in the left visual field, participants would tend to look for longer at this cue in comparison to if it were presented in the right visual field.
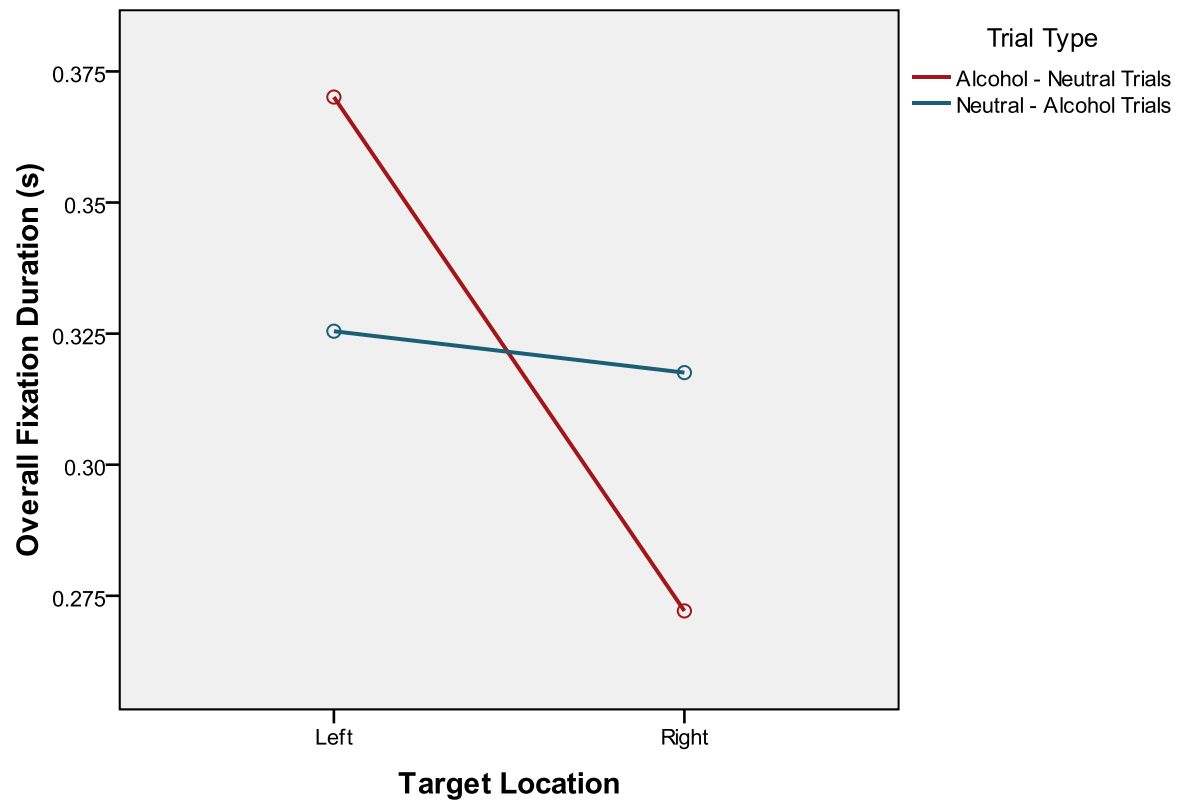
Figure 5: The mean overall duration of fixation in seconds to either the left or right picture in each trial type across both experimental groups (binge and non-binge drinkers), shown separately for trials where the alcohol picture is shown on the left and the right.

3.4 Overall fixation count

The number of fixations per picture within a pair was recorded by the eye movement equipment; analyses revealed a significant main effect for image side (F(1, 27) = 11.75, p = 0.002) as there were more fixations overall to the left (M = 0.86, SD = 0.09) than to the right (M = 0.51, SD = 0.05) (see *Figure 6*). This implies an attentional bias towards the left side pictures regardless of whether the picture is an alcohol or neutral picture or whether the individual was in the binger or non-binger experimental group.
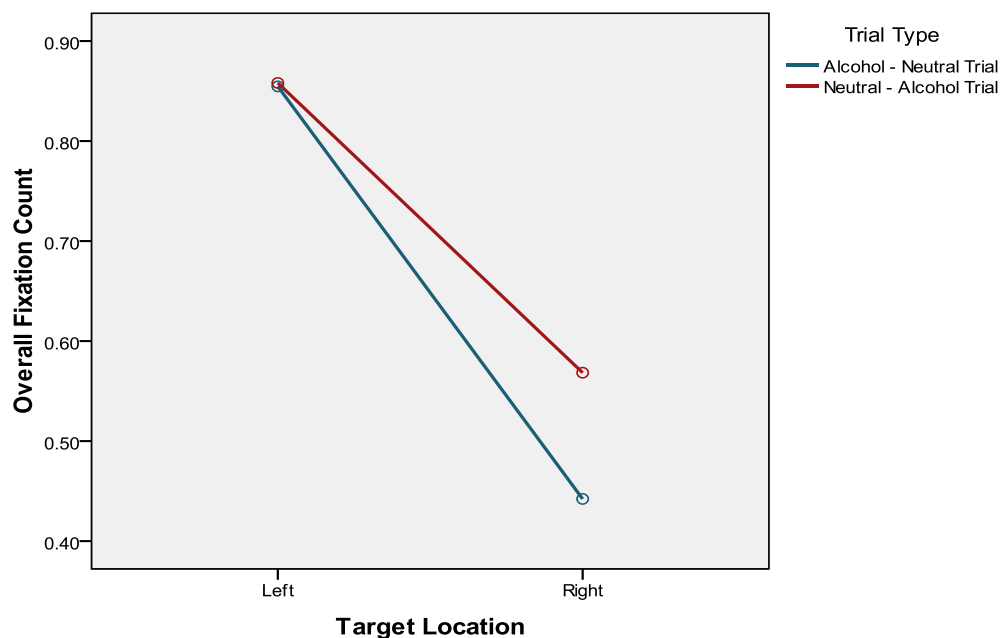
Figure 6: The mean overall fixation count to either the left or right picture across all alcohol trials which include data from both experimental groups combined (binge and non-binge drinkers).

3.5 Direction of initial fixation in the alcohol picture trials

To examine whether each group showed an attentional bias, a direction bias score was calculated for each participant by expressing the proportion of trials when the eye movement was directed initially towards the alcohol-related or neutral picture. Scores greater than 50% imply a bias in orientating towards alcohol-related pictures, relative to neutral pictures (50% indicates no bias; scores less than 50% indicate avoidance of alcohol-related pictures). Binge drinkers made their first fixation to the alcohol-related pictures on 53.32% of trials (SD = 21.12), which was not significantly greater than chance (50%), as shown by a one-sample t-test: $t(11) = 0.55$, p = NS. The non-binge drinkers made their first fixation to the alcohol picture on 54.04% of trials (SD = 14.10), which also did not differ significantly from chance (50%), $t(16) = 1.18$, p = NS. Comparison of the two groups on their direction of bias scores using an independent samples t-test did not show a significant result ($t(27) = -0.11$, p = NS). In addition, an overall bias for the alcohol cues across both groups was calculated at 54.08% and was also not significant $t(35) = 1.56$, p = NS. For further analysis, the alcohol bias score was correlated with measures of the BIS/BAS questionnaire (see *Table 3*). On the whole very few significant effects were found, apart from a significant negative correlation between alcohol bias and the BAS Drive scale. This implies that those participants who showed an alcohol bias also displayed reduced traits of the BAS drive scale, which is made of items pertaining to the pursuit of desired goals.

Table 3
A table to show correlations between alcohol bias and direction bias scores across all measures of the BIS/BAS questionnaire

	Alcohol Bias Scores		Direction Bias Scores	
	r(27)	*p-value*	*r(27)*	*p-value*
BIS	-0.05	NS	-0.21	NS
BAS – Drive	-0.38*	0.04	-0.14	NS
BAS – Fun Seeking	-0.19	NS	0.09	NS
BAS – Reward Response	-0.25	NS	-0.19	NS

*Correlation is significant at the 0.05 level (2-tailed).

3.6 Direction of initial fixation in the neutral-neutral picture trials

A direction bias score was also calculated for the neutral-neutral trials to examine whether each group showed an attentional bias towards the left or right visual field, and their direction bias scores were compared with 50% (which indicates no bias). Bingers made their initial fixation on the left-side pictures on 65.65% of trials (SD = 21.90), which was significantly greater than chance (50%) $t(11) = 2.48$, p = 0.03). The non-binger drinking group made their first fixation to the left-side pictures on 72.41% of trials (SD = 21.04) which also differs significantly from chance (50%) $t(16) = 4.39$, $p < 0.001$. However, comparison of the two groups on their left visual field

bias scores did not show a significant result, $t(27) = -.84$, p = NS. Nevertheless, the overall bias for the left visual field across both groups was calculated at 69.61% and was highly significant $t(28) = 4.96$, $p < 0.001$. This implies that for both experimental groups, there was an attentional bias for the pictures presented in the left visual field (see *Figure 7*). For further analysis, the direction bias score was correlated with measures of the BIS/BAS questionnaire, see *Table 3*. No significant effects were found.
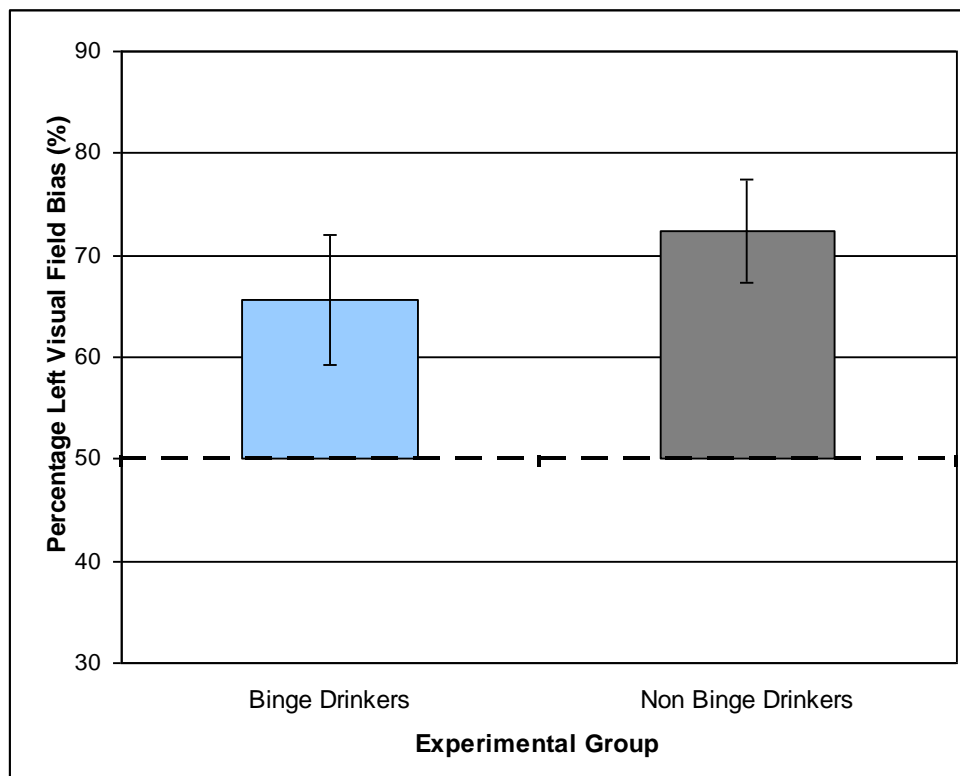

Figure 7: The percentage for the amount of time (in % with standard error bars) that gaze was directed at the left side picture in a pair, shown separately for binge and non-binge drinkers.

DISCUSSION

The current findings suggest that, relative to non-binge drinkers, binge drinkers do not show an enhanced attentional bias for alcohol related pictures. This is consistent with Stetter et al., (1995) and Johnson et al., (1995) who found that non-dependent control participants showed no significant attentional bias towards alcohol related cues. However, the present results conflict with those of Townshend and Duka (2001) and Field et al., (2004) who found that heavy social drinkers show an increased attentional bias for alcohol related stimuli. These conflicting results may be due to numerous methodological and circumstantial reasons. Previous investigations into non-dependent drinkers have looked specifically at heavy and light social drinkers, and these sub-types of social drinking may not be comparable to binge and non-binge categories. For example, Townshend and Duka (2001) divided heavy and light drinkers on the bases on how many units were typically drunk per week, heavy social drinkers drinking above 25 units and light social drinkers drinking less than 3 units per week on average. In the current investigation, social drinkers were

categorised on the basis of their binge score which provides a measure of the drinking pattern of the participant rather than just an indication of alcohol intake. From this method, there may be heavy and light social drinkers who would indiscriminately fall into sub-types of binge drinkers. Consequently, the representativeness of the alcohol attentional bias may be indeterminate.

Interestingly, reaction time data from the visual probe task suggested that for all experimental groups there was a generic slow down of responses to the probe when an alcohol picture was displayed. Reasons for this may derive from the emotional Stroop effect which suggests that stimuli which capture attention and slow response times are due to the emotional relevance of those stimuli for the individual (Stroop, 1935). The alcohol pictures may generally be of more interest and relevance to the university student population used in the current study. Therefore, interference from these cues may have used up fundamental processing which, in turn, may have inhibited the inclusive allocation of attention towards the instructional task.

An alternative explanation may relate to speed-accuracy trade-off given that participants responses were more accurate as well as slower at responding to the probe when an alcohol picture was displayed. This concept is well established (e.g. Pachella, 1974) and is illustrated as a linear association between reaction time and some measure of accuracy (Sanders & Rath, 1991). Interestingly, Lange (1888) found that people can often control their level of speed-accuracy trade-off, that is, manipulate and select their stance along a continuum of speed against accuracy. Lange (1888) suggested that individuals in tasks of reaction times can implement either a sensorial or a motor node or what Lange typically referred to as a "set", dependent on whether their attention was directed towards the stimulus or the response (see also James, 1890).

Lange (1888) postulated that accurate but slow performance which is reflected in the current study could be a result of adopting a sensorial node. Therefore, it can be inferred that alcohol related cues may have primed reaction times because of a potential implementation of a sensorial set.

Another interesting finding which emerged from the eye movement data is a highly significant left side bias across all experimental groups, elicited by each of the gaze measures (i.e. time to initial fixation, duration of first fixation, overall fixation length and fixation count). This implies that participants on the whole, tended to direct their attention more to the left side picture in the pair than the right regardless of whether it was an alcohol or non alcohol related picture. This perceptual bias has generally been found in investigating judgements on visual stimuli made by non clinical participants. Such a leftward bias has been demonstrated in a number of quite different tasks; choosing emotive features in chimeric faces (Luh, Rueckert & Levy, 1991); the 'greyscales' task where participants had to judge the brightness of stimuli (Mattingley, Bradshaw, Nettleton, & Bradshaw, 1994) and in tasks where participants were required to judge the size of stimuli (Nicholls, Bradshaw & Mattingley, 1999). This bias in non clinical individuals has been called *pseudoneglect* (Bowers & Heilman, 1980) to distinguish it from *neglect* in clinical individuals.

It was originally suggested (e.g. Manning, Halligan & Marshall, 1990) that pseudoneglect occurs as a result of left to right scanning that is required of English readers. This was supported by Chokron and DeAgostini (1995) who found the direction of the bias to be dependent on the participant's linguistic background, for example, individuals who read from left to right generally showed a leftward bias, while individuals such as readers of Hebrew who read from right to left displayed a rightward bias. However, recent work has provided an alternative explanation for

pseudoneglect suggesting that it is not scanning, but rather an attentional bias towards the right hemisphere itself that accounts for the leftward perceptual bias. This idea originates from Kinsbourne's (1970) idea on hemispheric asymmetry.

Despite this general leftward bias, there was also a discrepancy in directional bias between experimental groups, with the leftward bias results being driven primarily by the non-binge drinkers. Binge drinkers were found to generally have a right side bias when looking at a screen presenting two images, whereas non-bingers displayed a left side bias. Previous research into side bias has suggested that substance abusers show atypical side-bias when compared to standardised controls (Mandal, Bhushan, Kumar & Gupta, 2000). Because very little clarification has been suggested as to the reason why alcoholics display such a pattern, it could be premature to draw conclusions and to generalise these findings to non-dependent social drinkers. Nevertheless, it could be speculated that alcohol influences the dominant hemisphere (left) more adversely compared to the non-dominant hemisphere (right) which consequently, alters the natural display of bias for the contralateral visual side (Mandal et al., 2000).

Also of great interest, the current study found a correlation between those participants who showed a gaze-related alcohol bias (based on a bias in initial fixations), regardless of which experimental group they were in, with displayed traits of BAS scale of drive. This implies that those participants who showed an alcohol attentional bias also significantly displayed reduced traits of the BAS drive scale, which is made of items pertaining to the pursuit of desired goals. Although, in the current investigation, no personality differences were found between binge and non-binge drinkers, previous studies have shown differences for personality traits between different sub-types of alcohol drinkers. Townshend and Duka (2001) found that heavy drinkers show high scores for novelty seeking and reward dependence compared with occasional social drinkers. Additionally, high scores in novelty seeking have been found in only extreme patterns of drinking (bingeing) amongst social drinkers (Weissenborn & Duka, 2003). Whether the current finding of temperament for those who display an alcohol attention bias could have any predictive validity would require further exploration.

A considerable amount of previous research for an alcohol attentional bias for alcohol related cues in social drinkers used manipulations to elicit an attentional bias. These manipulations include induction of a negative mood, deprivation and ingestion of alcohol. According to previously referenced literature, attentional biases appear to be more prominent when the level of motivation to attain a particular substance is at its highest, as recorded by subjective craving. For example, for social drinkers the administration of a priming dose of alcohol increases attentional biases for alcohol related cues (Jones & Schulze, 2000; Townshend & Duka, 2001). In addition, Field and Powell (2007) found that for social drinkers, instigating a negative mood can enhance alcohol craving and generate a consequential increase in attentional bias for alcohol associated stimuli. Similarly, previous research with smokers suggests that a period of nicotine deprivation can enhance attentional and evaluative biases for stimuli related to smoking (Field et al., 2005). These accounts appear to be fit in with the concept that a common incentive salience mechanism may extract both subjective craving and selective attention towards substance associated stimuli (Robinson & Berridge, 1993). The current study did not use of any of these experimental manipulations to see if an unconditioned alcohol attentional bias was present in binge and non-binge drinkers. Therefore, based on the findings from previous research (Jones & Schulze, 2000; Field & Powell, 2007; Townshend &

Duka, 2001) which showed that using manipulations appear to elicit an attentional bias for social drinkers more readily, suggest that the use of alcohol priming effects seem to be central in order to uncover attentional biases for alcohol related stimuli in non-dependent alcohol drinkers.

There are some methodological limitations to the current study, which could be addressed in future investigations using this design. First, the pictorial stimuli presented in the visual probe task may be overly simplistic and are presented in an artificial context (on a black background) in pairs for artificially short time periods. The instructed task is also very simple, for example, pressing a button that corresponds to the appearance of an arrow. Taken together the simplicity of the stimulus and the simplicity of the task may be problematic. There may be the possibility of further increasing the complexity of the stimulus to provide a more realistic setting in which to measure alcohol attentional bias. For example, it would be possible to measure eye movements to 3D not 2D objects such as 'real life' table top pictures or bar scenes. Future research might take advantage of such stimuli and in doing so to investigate alcohol attentional bias at a greater level of complexity and reality than is possible with 2D images presented on a computer screen.

Enhanced real-life visual stimuli have been previously used for individuals with a social phobia of public speaking (Slater, Pertaub, Barker & Clark, 2006). It was found that individuals with social phobia showed increased signs of anxiety when they were speaking to a virtual audience compared with an empty room. They argue that to elicit the same anxiety they would normally experience in a similar real world situation, the experimental virtual reality needs to be sufficiently similar (Slater, et al., 2006). Furthermore, the current study failed to ask participants about their familiarity and personal relevance to the specific alcohol pictorial stimuli. Robinson and Berridge (1993) suggest that the apparent attraction of drug related stimuli and their ability to capture attention are important aspects of incentive salience, which sequentially affects the degree of activation of the dopaminergic system that controls addictive behaviour. Therefore, future studies should clarify with participants their familiarity and perceived salience of experimental stimuli.

Even though the innovative use of the eye movement tracking has been used in conjunction with the visual probe task, the eye movements have only been measured within the time frame (e.g. the current investigation used 3 seconds) of the brief exposure paradigms. Consequently, although the eye movement data which is obtained is likely to provide an accurate reflection of processes which are present during brief exposure tasks, the limitations of the brief exposure paradigms are still present. However, eye movement monitoring in future investigations are encouraged for attentional biases in substance related abuse, for the reason that the methods appear to be explicitly sensitive. It was notable that the present study and a majority of the previously referenced literature explored biases in attention for substance stimuli that was presented visually, but other substance related cues can also be perceived by other sensory modalities, for example by olfactory (smell), tactile (handling) and auditory (noise) sense. In light of this, future research in this area is encouraged to explore whether biases are enhanced in other sensory modalities as well.

All participants were university students who displayed an array of drinking patterns. When the sample was collectively looked at, findings from the reaction time latencies indicated an overall attentional distraction (reflected by RT slowing) for the alcohol related pictures. It is also worth highlighting here the finding that all participants showed a general gaze-related bias towards alcohol cues (as shown by the

significant interactions for the various measures of gaze), but this was more pronounced when the alcohol cues appeared on the left as opposed to the right. The bias was even found to be away from alcohol cues when such cues appeared on the right. The directional differences may be due to scanning effects and hemispheric asymmetry discussed earlier. However, importantly it was found that the alcohol cues influenced a gaze-directed bias across all experimental groups. This may have been due to participants becoming aware of the primary focus on alcohol which could have led to uncontrolled task demands. More specifically, participants were made aware the study was about alcohol as a large part of the investigation involved measuring alcohol consumption from questionnaire measures which asked about alcohol consumption. In addition, during the computer task alcohol related pictures were repeatedly displayed.

Further procedure limitations include order effects, as tasks were completed in a fixed order, and so all participants completed the visual probe task immediately after the questionnaire measures. Further research may want to present the questionnaire measures and visual probe task in a counterbalanced order, so as to control and assess potential order effects, such as fatigue. However, it may have been better to have presented questionnaires after the task, as this would have led to a reduced impact of task demands. For example, participants would have less of an opportunity to form their own hypotheses and expectations about the purpose of the visual probe task on the basis of their experience with the questionnaires. Notably, the current study used a relatively small sample of university students who were predominantly females. From evidence indicating gender differences in the factors influencing alcohol consumption (Walitzer & Sher, 1996), it is recommended that due to the high ratio of females used in the current investigation, caution should be taken before generalising the current findings to male populations.

Even though the hypothesis predicting that binge drinkers would have an enhanced attentional bias for alcohol related stimuli compared to non-binge drinkers has not been supported, there are important implications which need to be considered. From the small sample of 32 participants recruited, 33% of those were classified as 'binge drinkers', it is important here to note that advertisement did not include any prerequisite of alcohol consumption. Despite not finding any impairment in cognitive attentional processing, there is a health concern about the number of university students participating in such risky occasional drinking. Hunt (1993) suggested that intermittent binge drinkers may be more at risk for developing brain damage. Further research is needed to determine whether binge and non-binge drinkers show the attentional bias for alcohol cues as is commonly found in heavy and light social drinkers. The current findings indicate that this generalisation can not be made. However, the present investigation is to my knowledge, the first to explore alcohol attentional biases for binge and non-binge drinkers unconditioned to any alcohol priming cues, therefore further clarification is needed. As discussed earlier, a majority of research carried out into alcohol attentional biases for non-dependent social drinkers used alcohol priming methods in order to elicit attentional bias. Further research should explore the use of alcohol priming effects on binge and non-binge drinkers to see if an attentional bias can be elicited comparable with previous research, or if consistent with the current investigation an alcohol attentional bias is not apparent in binge drinking individuals.

CONCLUSION

In summary, the present results indicate that relative to non-binge drinkers, binge drinkers do not show an enhanced attentional bias for alcohol related pictures. These findings are inconsistent with previous research studying heavy and light social drinkers. Therefore, it is still a matter of debate as to whether binge drinker sub types of social drinking and heavy/light sub categories are experimentally comparable. This suggests that research into attentional bias examining different sub groups of social drinkers, should be cautious when generalising the findings to all social drinkers. Eye movement monitoring may have advantages over other methodology assessing for selective attentional biases, with biases towards the left visual field appearing to be particularly sensitive. Further work with this specific sub type of social drinkers is required to increase understanding and inform clinical interventions.

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