Investigating attentional bias in three differing alcohol consumption groups, and gender differentiation, utilising a visual dot probe

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**ABSTRACT**

Excessive alcohol consumption causes serious health problems. Research demonstrates that alcohol use is characterised by biases in the attentional processing of alcohol stimuli.

This study investigated 97, 18-25 year olds from Manchester Metropolitan University. Participants were split into a low (1-10 units p/w), moderate (11-20 units p/w), and high (21-30 units p/w) drinking group according to their response to the weekly alcohol indicator. Participants completed a dot probe task to elicit attentional bias towards alcohol stimuli.

*Part 1* aimed to determine whether moderate and high drinkers display an attentional bias for alcohol stimuli. *Part 2* aimed to determine whether females had a higher attentional bias than males, in the heavy drinking group.

Results indicated that moderate and high drinkers displayed a significant attentional bias towards alcohol stimuli. However, a significant difference between male and female attentional bias index scores in the high drinking group was not identified. Findings support addiction theories, where attention gained by one stimulus decreases the attention to another.

Findings from this study can notify health professionals that the focus of interventions needs to not only target heavy drinkers, but moderate drinkers as well in order to reduce the escalation of drinking behaviour.

**KEY WORDS:** ATTENTIONAL BIAS, ALCOHOL, DOT-PROBE TASK, MODERATE DRINKERS, GENDER
Introduction

Excessive alcohol abuse is a serious ongoing public health problem, with wide acknowledgements that consistent alcohol consumption is associated with a range of health conditions such as liver cirrhosis and cancer (British Medical Association, 2008). The annual cost of alcohol misuse in England and Wales has been estimated at £25 billion (Sheron et al., 2011). As well as alcohol use being associated with physical health decline and disease, alcohol use also has a significant effect on cognitive and attentional processes.

Research suggests that substance use is characterised by biases in the attentional processing of substance related stimuli, that is, substance-related stimuli acquire the ability to grab the user's attention (Field & Cox, 2008). Thus attentional bias is 'a phenomenon where by attentional channelling is directed towards personally valued stimuli, despite an individual's efforts to ignore them' (Williams et al., 1996, p.3). Therefore it is fair to suggest that attention is not evenly distributed, in that the attention gained by one stimulus decreases the attention to another (Mathews & Macleod, 2002).

Several theories have provided explanations for the acquisition of an attentional bias from substance use and addiction. Classical conditioning theory posits that through the process of conditioning, 'a substance can be associated with environmental stimuli that are contiguous with and contingent on the effects of a specific substance' (Fields & Cox, 2008, p.8). As a consequence the individual orients their attention towards a predictive conditioned stimulus when it is experienced in the environment (Bindra, 1974; Pearce & Bouton, 2001) due to availability expectancy (Robinson & Berridge, 1993, 2001).

A motivational perspective focuses on goal pursuit (Bindra, 1992; Toates, 1994; Cox & Klinger, 1988, 2004), an individual's motivational state biases attentional processing towards substance-related stimuli. The goal of using acts as a continuous distraction, thus causing the individuals attention to be continuously directed towards attaining their goal by selectively and automatically responding to substance-related stimuli (Klinger & Cox, 2004).

The integrated theories of addiction consider conditioning with cognitive neurobiological psychological perspectives. The incentive-sensitization model (Robinson & Berridge, 1993, 2001) posits that drug use causes lasting neuro-adaptations in the brain. A sensitised dopaminergic response for a substance and related stimuli is caused by frequent intermittent consumption of the substance (Robinson & Berridge, 1993, 2001). Such a sensitised response dictates an interpretation of the substance to be salient and acquire strong motivational properties (Field & Cox, 2008; Field et al., 2009). However the ability of a drug to induce sensitization is powerfully modulated by associative learning (Robinson & Berridge, 2001). Thus through mechanisms of classical conditioning, substance-related stimuli induce dopaminergic responses (Di Ciano et al., 1998). A consequence of this is that it 'grabs attention, becomes attractive and wanted', and thus guides behaviour to the incentive (Robinson & Berridge, 1993, p.5) leading to the development of attentional bias (Duvauchelle
As a consequence, attentional biases are strongly associated with drug seeking behaviour (Field & Cox, 2008).

Subjective craving is a continuous measurable state (Franken, 2003) that is considered a central phenomenon for continuing drug use (Everitt, 1997). Research utilising social drinkers demonstrates a positive correlation between attentional bias and subjective craving (Field et al., 2004; Field et al., 2005; Vollstadt-Klein, 2011). Franken (2003) suggests that attentional bias and subjective craving exist within a mutual excitatory relationship. Subjective craving increases when attention is focused on substance-related stimuli, and in turn the salience of such substance-related stimuli is increased. Attentional bias has been theorised as being caused by, and an outcome of craving (Weinstein & Cox, 2006), such a notion is supported by Ryan (2002) and Kavanagh et al. (2005).

Various methods have been utilised to measure substance-related attentional bias such as the addiction Stroop task (Stroop, 1935) and the visual dot-probe (MacLeod et al., 1986). During the Stroop task an attentional bias is inferred when an individual's performance on the primary task is impaired in the presence of substance-related stimuli (Field & Cox, 2008). However varying Stroop interference results across studies may be due to carry over effects (Waters et al., 2005) and differing presentation formats (block/mixed presentation) (Waters & Feyerabend, 2000). Furthermore results from the Stroop task may not be explained as an 'attentional bias', but as a generic cognitive slowdown due to craving (Field & Cox, 2008).

The visual dot-probe is a direct measure of visuo-spatial attentional allocation (MacLeod et al., 1986). Substance-related stimuli and control stimulus are simultaneously presented on a screen, participants are instructed to respond to the probe replacing one of the stimuli. Koster et al. (2004) stated that response times will be faster when the probe appears in a spatial location where attention is already allocated. Thus it is assumed that substance-users relative to non-substance users will be quicker to respond a dot-probe replacing substance-related stimuli, hence forth demonstrating an attentional bias for substance-related stimuli (Field & Cox, 2008).

Stimulus presentation times (stimulus onset asynchrony), appear to be an important parameter when measuring attentional bias, as times ranging from 17-2000 ms have produced conflicting results (Field & Cox, 2008). Noel et al. (2006) found an attentional bias in abstinent alcoholics at 50 ms but not at 500 ms, whereas Field et al. (2004) found an attentional bias in heavy drinkers at 500 ms but not at 200 ms. Short stimulus onset asynchrony's (SOA) elicit biases in initial orientating (Duncan et al., 1994), whereas long SOA's elicit biases in disengagement. Despite slight variation in results, the visual dot probe task has successfully measured attentional bias towards various addictive substances such as opiates (Constantinou et al., 2010; Garland et al., 2012), cocaine (Tull et al., 2011), tobacco (Ehrman et al., 2002), alcohol (Townshend & Duka, 2007) and ketamine (Morgan, 2008).
Placing research within the field

A vast amount of research demonstrates the presence of an attentional bias for alcohol-related stimuli in heavy drinkers relative to light drinkers utilising the addiction Stroop task (Sharma et al., 2001; Lusher et al., 2004; Fadardi & Cox, 2006; Field et al., 2007). Utilising a pictorial dot probe task, Field et al. (2011) found that heavy social drinkers demonstrated an attentional bias towards alcohol-related stimuli. Such findings are supported by Field et al. (2013) who also found that abstinent alcoholic patients exhibited a greater attentional bias towards alcohol-related stimuli relative to social drinkers.

Leading on from this, Townshend & Duka (2001) investigated attentional bias in relation to alcohol in a non-clinical sample utilising a visual dot probe task. Participants were split into heavy (25 units per week) and light drinking groups (no specification). Mean bias scores indicated that heavy social drinkers showed an attentional bias towards alcohol related stimuli in comparison to light drinkers.

Similarly Field et al. (2004) compared heavy (at least 20 units per week) and light (less than 10 units per week), establishing that heavy drinkers displayed an attentional bias for alcohol-related stimuli in comparison to light drinkers. Moreover, it is commonly suggested that the degree of an attentional bias is proportional to the quantity and frequency of alcohol consumption (Field & Cox, 2008). The aforementioned studies highlight a need to investigate, a previously unconsidered, moderate alcohol consumption group of 11-20 units per week. Such an investigation has been prompted by the notions of Robinson & Berridge's (1993) incentive-sensitisation theory which predicts that attentional bias develops gradually with each subsequent use. Thus there is a feasible expectation for the presence of an attentional bias in the moderate drinking group.

Leading on from this, based on the knowledge of the mutual excitatory relationship between attentional bias and subjective craving (Franken, 2003; Ryan, 2002). It is important to ascertain whether moderate drinkers do posses an attentional bias for alcohol-related stimuli because such biases induce subjective craving and vice-versa. Thus increasing the potential of alcohol seeking and using behaviour which may become problematic. The presence of such a bias is associated with the maintenance of addictive behaviour (Fadardi & Cox, 2009), therefore if we are aware of an attentional bias in moderate drinkers then alcohol attentional control training programmes (AACTP) can be utilised within this group, in order to reduce further increase in alcohol consumption.

The utility of AACTP has been demonstrated with the reduction of alcohol attentional bias in harmful and hazardous drinkers (Schoenmakers et al., 2007; Fadardi & Cox, 2009). Fadardi & Cox (2009) found a post attentional training reduction in alcohol consumption in the harmful drinkers group. Moreover, Schoenmakers et al. (2010) found that attentional bias modification training was effective in increasing abstinent alcoholics ability to disengage from alcohol
related cues, thus further demonstrating the effectiveness of attentional bias modification training.

**Investigating potential gender differentiation**

Alcohol consumption is also associated with deficits in response inhibition (Noel & Van Der Linden *et al*., 2005; Hildebrandt *et al*., 2004). Response inhibition refers to the mechanism of inhibiting approach tendencies to rewarding, appetitive stimuli (Nederkoorn *et al*., 2009). Such a notion is supported by Goldstein and Volkow (2002) who found that drug users display reduced inhibitory responses to stimuli that are associated with their substance of abuse.

Townshend & Duka (2005) found that in comparison to non binge drinking females, female binge drinkers displayed stronger deficits in inhibitory control function. However this was not found in males. Leading on from this, during a modified stop signal task heavy drinking women displayed poorer response inhibition in comparison to light drinking women, and in comparison to light and heavy drinking males (Nederkoorn *et al*., 2009). Furthermore, utilising an alcohol go/no-go task Kreusch *et al*. (2013) found that female problem drinkers displayed greater rates of false alarm errors for no-go alcohol stimulus relative to male problem drinkers, however it must be considered that the effect was close to statistical significance ($p=0.052$). Such results indicate cognitive differences between males and females, specifically heavy drinking male and females.

Based on the aforementioned evidence of cognitive deficits in response inhibition in the high drinking female population, it is feasible to consider that there may be similar cognitive deficits in attentional bias. Thus highlighting a need to consider gender as a potentially impacting variable on attentional bias when drinking at a high level.

**Hypotheses**

**Part 1**

1. It is hypothesised (One-Tailed) that individuals in the high drinking group will display an attentional bias, as indicated by faster reaction times, towards alcohol related stimuli in comparison to neutral stimuli, and in comparison to the low and moderate group.

2. It is hypothesised (One-Tailed) that individuals in the moderate drinking group will display an attentional bias, as indicated by faster reaction times, towards alcohol related stimuli. In comparison to neutral stimuli, and in comparison to the low group.

**Part 2**

3. It is hypothesised (One-Tailed) that females in the high drinking group will demonstrate a greater attentional bias, as indicated by faster reaction times towards alcohol-related stimuli. In comparison to males in the high drinking group.
Method

Design

A mixed-experimental design is utilised for both **part 1** and **part 2**. An experimental design has been selected for the purpose of this research as experimental designs allow a causal relationship between variables to be identified (Breakwell *et al.*, 2012).

**Part 1** is a 2x3 mixed-experimental design. The between subjects independent variable is average weekly alcohol consumption (AWAC) (1-10 units per week (*low*), 11-20 units per week (*moderate*), 21-30 units per week (*high*). The within subjects independent variable is dot probe location, *congruent* (dot probe replaces alcohol-related stimuli), and *incongruent* (dot probe replaces neutral stimuli). The dependent variable is reaction time on the dot probe task (in milliseconds).

**Part 2** is a mixed-experimental design. The between subject independent variable is gender (male or female), and the dependent variable is the attentional bias index score of the *high* alcohol group, 21-30 units per week.

Participants

Participants for this study were recruited via an opportunity sampling method. A specific target population of individuals who drink a minimum of one alcoholic beverage per week (Neederkoorn, 2009) and a target population age range of 18-25 years was utilised. Posters were displayed around Manchester Metropolitan University Psychology department inviting individuals to take part in this research. A power analysis was conducted using G*Power 3.1.3 (Faul *et al.*, 2007) at a significance level of 0.5, a power of .80 and a small effect size (Cohen's d = .25), which determined a minimum sample size of 60 participants.

**Part 1** utilised 97 individuals who were split according to weekly alcohol consumption into a *low* (*N*=24), *moderate* (*N*=53) and *high* (*N*=40) group. **Part 2** utilised the dot probe data from the *high* drinking group (*N*=40) from **Part 1**. The *low* drinking group had a mean age of 21.6 years, the *moderate* drinking group had a mean age of 21.4 years and the *high* drinking group had a mean age of 21.8 years.

Apparatus

A short form questionnaire (*Appendix 5*) requiring participant number, gender, age and the quantity of alcohol consumed on average per week was utilised for the research. Alcohol consumption was indicated by ticking one of three average weekly alcohol indicators (AWAI): 1-10 units per week (*low*), 11-20 units per week (*moderate*) and 21-30 units per week (*high*). Participants were provided with a 'unit conversion chart' within the questionnaire in order to convert their weekly drinks into units with ease (*Appendix 5*). 1-10 units per week and 21-30 units per week are categorisations of light/heavy drinkers.
successfully utilised in previous research (Duka et al., 1999; Field et al., 2004), and have been used to define the moderate group (11-20 units per week) for this research.

Moreover, an information sheet (Appendix 2) was constructed to explain the process of the research, and an informed consent form, which included the participants identification number and a signature box (Appendix 3). The information sheet and the informed consent form contained ethical inclusions such as data protection, the right to withdraw and anonymity. Furthermore, standardised task instructions (Appendix 9) were administered to explain the procedure of the computerised task.

A pictorial visual dot probe task (MacLeod et al., 1986) was utilised to measure and elicit attentional bias towards alcohol related stimuli. A visual dot probe task was selected for use in order to address the research aims, as it allows the distribution of visual attention to be assessed. Furthermore, the results of the dot probe will allow the presence of an attentional bias to be defined (Townshend & Duka, 2001). Moreover, research has demonstrated the dot probe to be a successful method of measuring attentional bias in relation to alcohol (Townshend & Duka, 2001; Field et al., 2004; Field et al., 2005).

The pictorial dot probe task consisted of 56 images sourced from various websites. 24 images of alcohol related stimuli such as pints/bottles of beer, wine glasses/bottles, spirit bottles and pub signs (Kreusch et al., 2013) (Appendix 6a & 6b), and 32 images of household objects (Appendix 7) were utilised. Alcohol pictures were selected for use as stimuli opposed to words, as pictorial stimuli induce better reward related responses associated with the development of an attentional bias, further more pictorial stimuli are also considered to be more ecologically sound (Bruce & Jones, 2004; Townshend & Duka, 2001).

The pictorial dot probe task software was designed by a Manchester Metropolitan University (MMU) computer technician. The pictorial stimuli utilised within the dot probe task were edited to a standardised size of 100mm x 125mm (Field et al., 2005) and changed to gray scale in order to ensure consistency between pictorial stimuli.

The task began with standardised onscreen instructions (Appendix 8) which allowed the participant to initiate the task once ready, and complete 4 practice trials utilising 4 pairs of household/office images in order to familiarise themselves with the task lay out. Moreover, pictorial stimuli for the test trials were organised into 24 pairs; one alcohol-related image (congruent) and one neutral image (incongruent), and were presented in a semi random manner to ensure that dot probes did not appear consecutively in the same location.

A 20mm central fixation cross appeared on screen for 500 m/s followed by an image pair presented for 500 m/s (Townshend & Duka, 2001; Field et al., 2004; Field, Mogg & Bradley, 2005). One image appeared on the left of the visual display, and one image appeared on the right of the visual display. After the 500 m/s presentation time, both images disappeared and one image was immediately replaced by a dot probe, which remained until a response was made regarding the dot probe location. The ‘F’ key was utilised to respond to the
dot probe appearing on the left of the visual display, and the ‘k’ key was utilised to respond to the dot probe appearing on the right of the visual display. Each image pair was presented four times, once for each possible presentation variable; picture location, left/right and dot probe location, congruent/incongruent; totalling 96 presentations.

The dot probe software recorded response times for congruent (alcohol-related stimuli) and incongruent (neutral stimuli) which were transferred automatically to a data spread sheet. The software also recorded error rates for all 96 trials. An attentional bias is inferred by a faster response time when the visual dot probe replaces alcohol related stimuli (congruent) in comparison to neutral stimuli (incongruent).

All participants were issued with a debrief form (Appendix 4) which included an overview of the study aims, researcher contact details, and the reinstating of the right to withdraw.

Ethical Considerations

This research has been conducted in accordance with the British Psychological Society code of ethics and conduct (BPS, 2009). The structure of the codes are based on four ethical principles; respect, competence, responsibility and integrity. Furthermore, this research has been carried out alongside MMU departmental ethical guidelines and an AEAF form has been completed and discussed with a supervisor (Appendix 1). In reference to this research, no special considerations were required to work with such participants.

Moreover, participants were provided with an information sheet (Appendix 2), provided informed consent by signing the consent form (Appendix 3) and were given the right to withdraw at any point. Participant information and data was protected, participant identity and participant data remained anonymous by utilising participant numbers when discussing task findings. Furthermore, participants were administered with a debrief form (Appendix 4) outlining the research aims, reinstating their right to withdraw, and contact details of relevant MMU support services.

Procedure

Participants received a information sheet (Appendix 2) and an informed consent form (Appendix 3), including their participant number and required consenting signature. Participants were then administered with a questionnaire (Appendix 5) which recorded their average weekly alcohol consumption, age and gender. After reading the information sheet, signing an informed consent form and completing a questionnaire, participants sat at a desk in front of a laptop.

In order to reduce any potential extraneous variables the task was completed by each participant at the same desk and laptop arrangement within a quiet environment. Participants viewed onscreen instructions (Appendix 8), stated their participant number and completed a practice trial followed by the actual 96-
trial dot probe task. Moreover, task instructions (*Appendix* 9) were also placed next to the laptop in paper form to ensure clarity of expected task procedures. The use of standardised instructions reduces the chance of potential investigator effects and ensures equality between participants. Participants responded to the dot probe locations as quickly as possible utilising the instructed response keys, which were each highlighted with a florescent pink sticker for clarity of response key location. Upon completion of the task a message appeared to inform the researcher and a debrief form (*Appendix* 5) was administered.

**Results**

**Study 1**

Reaction time (in milliseconds) for the detection of dot probe position, whether *congruent* (replacing alcohol-related stimuli) or *incongruent* (replacing neutral stimuli) as recorded for low (n=24), moderate (n=32) and high (n=40) alcohol consumption groups, utilising a visual dot probe task were entered into SPSS 19.

**Preparation of Data**

The data was screened for reaction times below 200ms or more than 2000 ms (Townshend & Duka, 2001) however no participants fell into this category. No participants were removed due to incorrect responses. Participant 4 was removed due to the fact that their reaction time was 3 standard deviations above the mean (Field *et al.*, 2004). All analysis and graphs were derived from SPSS outputs (*Appendix* 10).

**Table 1** provides mean reaction times (in milliseconds) and standard deviations for the three alcohol groups when the dot probe replaced alcohol-related stimuli (*congruent*) and neutral stimuli (*incongruent*).

<table>
<thead>
<tr>
<th></th>
<th>Low (SD)</th>
<th>Medium (SD)</th>
<th>High (SD)</th>
<th>Whole sample (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Congruent</strong></td>
<td>.392 (.04)</td>
<td>.399 (.04)</td>
<td>.388 (.03)</td>
<td>.393 (.04)</td>
</tr>
<tr>
<td><strong>Incongruent</strong></td>
<td>.405 (.06)</td>
<td>.476 (.07)</td>
<td>.506 (.07)</td>
<td>.470 (.08)</td>
</tr>
</tbody>
</table>

A 2x3 Mixed Factorial ANOVA was performed, an ANOVA is an analysis of variance which tests for differences between groups (Dancey & Reidy, 2011). The within-subjects independent variable was dot- probe position (*congruent* and *incongruent*), the between- subjects independent variable was alcohol group (*low, moderate, high*), and the dependent variable was time taken to respond to probe location (in milliseconds). A significant main effect was found for dot probe position, $F(1,93) = 121.86$, $p < .001$. A significant main effect for
alcohol was also identified, $F(1,93) = 8.92, p < .001$. Furthermore, a significant interaction effect was found, $F(1,93) = 23.61, p < .001$.

**Figure 1.** demonstrates the significant interaction effect found.

![Figure 1](image.png)

**Figure 1** is a means plot to demonstrate the significant interaction between participant group (Low, Moderate, High), and dot probe position (congruent/incongruent). As a significant interaction was found within the ANOVA, Post Hoc tests were performed to analyse the interaction indentified. 3 paired-samples t-tests and 3 independent sample t-tests were conducted. Thus, a Bonferroni Correction was required to control for familywise error rates for 6 pair wise comparisons, $(.05/6=.0083)$ sets a new alpha significance level of $p < .0083$ (Welkowitz et al., 2012).

The first paired-samples t-test was for the high alcohol group, where the independent variable was dot probe position (congruent/incongruent) and the dependent variable was reaction time (in milliseconds). The high alcohol group demonstrated a significant difference in dot probe reaction times in congruent and incongruent positions, $t(39) = 12.84, p < .0083$, $d=2.23$, this shows a large effect size. High alcohol users responded significantly faster to the probe in congruent ($M=.388$) in comparison to incongruent ($M=.506$) positions.

The second paired-samples t-test was for the moderate alcohol group, where the independent variable was dot probe position (congruent/incongruent) and the dependent variable was reaction time (in milliseconds). The moderate alcohol group demonstrated a significant difference in dot probe reaction times

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1 It is suggested that when a statistically significant effect is reported, an effect size should also be reported. A measure of effect size is intended to provide a measurement of the absolute magnitude of an effect (Gravetter & Wallnau, 2013). A method for assessing effect size which has been utilised within this report is Cohen’s $d$. Cohen (1992) suggested that effect size can be standardised by measuring the mean difference in terms of standard deviation. Cohen (1992) suggested a criteria for evaluating the size of effect: $d = 0.2$ is a small effect size, $d = 0.5$ is a medium effect size, and $d = 0.8$ is a large effect size.
in congruent and incongruent positions, $t(31) = 6.12, p < .0083, d = 1.31$, this shows a large effect size. Moderate alcohol users responded significantly faster to the probe in congruent ($M = .399$) in comparison to incongruent ($M = .475$) positions.

The third paired-samples t-test was for the low alcohol group, where the independent variable was dot probe position (congruent/incongruent) and the dependent variable was reaction time (in milliseconds). The low alcohol group did not demonstrate a significant difference in dot probe reaction times in congruent ($M = .393$) and incongruent ($M = .404$) positions, $t(23) = 1.31, p > .0083, d = 0.24$, this shows a small effect size.

An attentional bias index score (ABI) was calculated for use as the dependent variable in the independent samples t-tests. The ABI was calculated by subtracting the mean congruent reaction time from the mean incongruent reaction time (Townshend & Duka, 2001). A positive ABI score demonstrates an attentional bias towards alcohol related stimuli, opposed to a negative ABI score which indicates avoidance of alcohol related stimuli (Koster et al., 2004). Furthermore, a greater attentional bias index score indicates a larger attentional bias towards alcohol-related stimuli.

The first independent sample t-test was to compare ABI scores, where the independent variable was alcohol group (low and high) and the dependent variable was ABI score. Levene’s test for equality of variance was significant, thus equal variances were not assumed. The ABI score was significantly different between the low and high alcohol group, $t(57.82) = 8.13, p < .0083, d = 2.02$, this shows a large effect size. The high alcohol group had a significantly higher ABI score ($M = .117$) than the low alcohol group ($M = .012$).

The second independent sample t-test was to compare ABI scores, where the independent variable was alcohol group (medium and high) and the dependent variable was ABI score. Levene’s test for equality of variance was not significant, thus equal variances were assumed. The ABI score was significantly different between the moderate and high alcohol group, $t(70) = 2.80, p < .0083, d = 0.64$, this shows a medium effect size. The high alcohol group had a significantly higher ABI score ($M = .117$) than the moderate alcohol group ($M = .076$).

The third independent sample t-test was to compare ABI scores, where the independent variable was alcohol group (low and moderate) and the dependent variable was ABI score. Levene’s test for equality of variance was significant, thus equal variances were not assumed. The ABI score was significantly different between the low and moderate alcohol group, $t(52.94) = 4.12, p < .0083, d = 1.09$, this shows a large effect size. The moderate alcohol group had a significantly higher ABI score ($M = .076$) than the low alcohol group ($M = .012$).

**Study 2**

A further independent t-test was performed, where the independent variable was gender (male/female) and the dependent variable was ABI score, using data
only from the high drinking group. Analyses revealed that there was no significant difference between males ($M=0.019$) and females ($M=0.008$), whilst males had a slightly higher ABI score, this was not significantly so. Levene’s test for equality of variance was not significant, thus equal variance was assumed, $t(22) = .602, p > .0083$.

**Discussion**

The present study part 1, found that the high drinking group responded significantly faster to the dot probe in the congruent positions, than the incongruent positions. Moreover, the high drinking group responded significantly faster to the dot probe in the congruent position than the moderate drinking group. The present study further identified that the low drinking group did not demonstrate a significant difference in response times to the dot probe in congruent and incongruent positions.

Leading on from this, part 1 found that the moderate drinking group responded significantly faster to the dot probe in congruent positions, then the incongruent positions. The present study further identified that the moderate drinking group had a significantly higher attentional bias index score than the low drinking group, thus demonstrating a larger attentional bias towards alcohol related stimuli. Therefore, part 1 successfully identified that heavy drinkers demonstrated a significant attentional bias towards alcohol-related stimuli in comparison to neutral stimuli, and in comparison to low and moderate drinkers. Furthermore, part 1 successfully identified that moderate drinkers demonstrated a significant attentional bias towards alcohol-related stimuli in comparison to neutral stimuli, and in comparison to low drinkers. Thus, the above findings support hypothesis 1 and 2.

The findings from part 1 are supported by the motivational model of addiction (Bindra, 1992; Cox & Klinger, 1988, 2004; Toates, 1994), in that the motivational state of the individual biases their attention towards attaining their goal by selectively and automatically responding to substance related stimuli (Klinger & Cox, 2004). Leading on from this, findings from part 1 also provide support for the incentive-sensitisation (Robinson & Berridge, 1993, 2001) model of addiction, which posits that a sensitised dopaminergic response for a substance and substance-related stimuli, induced by frequent use of a drug, dictates a salient interpretation of the substance. Thus behaviour is guided towards the incentive (Robinson & Berridge, 1993, 2001) which leads to the development of an attentional bias for such a substance (Duvauchelle et al., 2000).

The presence of an alcohol-related attentional bias in the high and moderate alcohol group is supported by Mathew & Macleod (2002) who stated that the attention gained by one stimulus decreases the attention to another, thus resulting in faster reaction times to alcohol related stimuli. Leading on from this the presence of an attentional bias towards alcohol-related stimuli in the high drinking group is consistent with many similar studies (Fadardi & Cox, 2006; Field et al., 2013; Field et al., 2011; Field et al., 2004; Lusher et al., 2004; Sharma et al., 2001; Townshend & Duka, 2001).
Part 1 findings highlighted the presence of a significant attentional bias towards alcohol-related stimuli in the moderate drinking group, which has not been previously investigated or identified in attentional bias research. The presence of an attentional bias in the moderate drinking group may be explained by the notions of Robinson and Berridge's (1993) incentive-sensitisation theory, which posits that an attentional bias develops progressively with each subsequent substance use. Much of the previous research put forward the notion that the degree of an individual's alcohol-related attentional bias is proportional to the quantity and frequency of alcohol use (Field & Cox, 2008; Field et al., 2004; Townshend & Duka, 2001), this appears to support and explain the findings of part 1.

In support of the notion that attentional bias is proportional to the quantity of alcohol use, the attentional bias identified in the high drinking group was larger, as indicated by a slightly faster response time to the probe in the congruent position, than the attentional bias in the moderate group. Moreover, the progressive increase in attentional bias towards alcohol-related stimuli between the moderate and high drinking group thus demonstrates the notion of a progressive development of attentional bias, encapsulated within the incentive-sensitisation theory (Robinson & Berridge, 1993, 2001).

Leading on from this, the presence of an alcohol-related attentional bias in the moderate and high drinking group, which became progressively larger according to drinking group, could also be explained by the model put forward by Franken (2003). Such a model suggests that attentional bias and subjective craving exist within a mutually excitatory relationship. The presence of an attentional bias leads to subjective craving for the substance, and in a reciprocal manner, subjective craving leads to an increased attentional bias for the alcohol-related stimuli (Weinstein & Cox, 2006). Franken's (2003) model appears to explain and support the findings from part 1.

The identification of an alcohol-related attentional bias within the previously unexplored moderate drinking group highlights an 'at risk' population to health professionals. The presence of an attentional bias is associated with the maintenance of addictive behaviours (Fadardi & Cox, 2009) and are strongly associated with drug seeking behaviour (Field & Cox, 2008). Thus, both moderate and high drinking group individuals have the potential to engage in more dangerous levels of drinking behaviour, through the reciprocal relationship between attentional bias and subjective craving (Franken, 2003; Kavanagh et al., 2005; Ryan, 2002).

The findings from this research reinstate a need for health professionals to target both moderate and high range drinkers. In order to implement interventions that target alcohol-related attentional biases, and reduce potential escalation of drinking behaviours. The use of alcohol attentional control training programmes (AACTP) have been successfully utilised in reducing alcohol-related attentional biases in harmful drinkers (Fadardi & Cox, 2009; Schoenmakers et al., 2007) and abstinent alcoholics (Schoenmakers et al., 2010). Thus AACTP may be appropriate for the treating the populations
discussed within this research. Moreover, the results from part 1 could be confidently generalised to the wider student population.

Part 2 aimed to identify whether females in the high drinking group displayed a greater attentional bias than males in the high drinking group. Findings indicated that in fact males displayed a greater alcohol-related attentional bias, however such a difference was not statistically significant. Therefore hypothesis 3 was not supported.

The findings from part 2 contradicted the notion that there may be cognitive differences between male and female heavy drinkers. Poorer inhibitory control function found in female heavy drinkers, but not in male heavy drinkers (Kreusch., 2013; Nederkoorn et al., 2009; Townshend & Duka, 2005) prompted the notion that similar cognitive deficits may be found in attentional bias for females, however part 2 research findings did not support such a notion.

A potential explanation for the presence of a higher attentional bias in high drinking group males, opposed to the hypothesised high drinking group females, albeit a insignificant difference, may relate to the idea of current concern (Klinger & Cox, 2004). A vast number of the alcohol stimuli utilised within the dot probe were related to beer, which may be interpreted as more male orientated. Thus if the alcohol stimuli did not sufficiently relate to the females current concerns, and related more to a male current concern, then this would provide a feasible explanation as to why males in the high drinking group displayed a greater alcohol-related attentional bias than females. However it must be reinstated that the difference was not statistically significant, thus gender does not appear to be an impacting variable on attentional bias.

Real-World Implications of Findings

The research findings indicate an alcohol-related attentional bias in the moderate and high drinking group. As previously discussed, such knowledge can guide health professionals and emphasises a need for not only the drinking behaviours of heavy drinkers to be at the focus of interventions, but also moderate drinkers too. The presence of an attentional bias is associated with the maintenance of addictive behaviours (Fadardi & Cox, 2009). Thus, via the mutually excitatory relationship between attentional bias and subjective craving, both population groups pose a risk of increased drinking behaviour that must be targeted.

Limitations

One limitation of this research is that the use of a specific sample criteria of 18-25 year old individuals who drink a minimum of one alcoholic beverage a week, from Manchester Metropolitan university dictates that such findings can only be generalised to the wider student population, and not the general population.
Strengths

A strength of this study is that it has identified an attentional bias in a previously unexplored population, moderate drinkers. A further strength is that the research findings can notify health professionals of a need to target moderate drinkers, as well as high drinkers during intervention. Moreover, the use of a robust sample size adds strength to the findings of this research.

Future Research

In light of carrying out this research, it would be beneficial for future studies to utilise word stimuli as well as pictorial stimuli to assess whether an attentional bias in the moderate drinking group is still identified with the use of word stimuli. Moreover, future studies should investigate non-student populations, in conjunction with varying SOA's. Furthermore, there is limited research on the efficacy of attentional retraining programmes, thus future research should focus on the efficacy of such programmes to reduce alcohol-related attentional bias in moderate and high drinking individuals. Explorations into the area of attentional retraining would provide insight into the methods that could be deemed effective at reducing the widely documented phenomenon of alcohol-related attentional biases.

Conclusion

In conclusion, findings implicate strong evidence that moderate alcohol consumers (11-20 units p/w) and high alcohol consumers (21-30 units p/w), elicit an attentional bias towards alcohol-related stimuli in comparison to neutral stimuli. Moreover, such an alcohol-related attentional bias appears to increase according to alcohol consumption group. However, a significant difference between male and female attentional bias scores in the high drinking group was not identified.

Leading on from this, the identification of an alcohol-related attentional bias in both the moderate and high drinking group within this research highlights two population groups that are at significant risk of increased drinking behaviour. Such findings should urge health professionals to put into place appropriate interventions to reduce alcohol-related attentional bias so that drinking behaviour does not increase.

References


