An investigation into the relationship between laboratory measured attentional bias and real life attentional bias for alcohol-related cues and its role in alcohol behaviour

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June 2015

Submitted in partial fulfilment of the Doctorate of Clinical Psychology

University of Liverpool

Abstract

There is a large evidence-base suggesting the role of attentional bias in addictive behaviours. However, there has been no evidence to date of any research in the field of alcohol addiction that investigates if traditionally used laboratory-based measures of attentional bias correspond to more naturalistic methods in real-world settings. A non-clinical sample of 43 students aged 18-30 were recruited from the University of Liverpool. Participants completed two measures of attentional bias; a fixed eye tracker measure utilising the visual probe task in a standard laboratory set-up, and a head mounted eye tracker within a more naturalistic setting. Attentional bias was measured by participants fixation duration to alcohol compared with non-alcohol/neutral stimuli. Participant's drinking habits were also measured using the Time Line Follow Back and the Alcohol Use Disorders Identification Test. A measure of craving and measures of mood were also administered. Correlation analyses were conducted on 34 complete data sets. No significant correlations were found between the two measures of attentional bias. Some significant correlations were found, however, between drinking-related variables, craving and the fixed eye tracker attentional bias measure supporting previous findings within the literature. Additional analyses were conducted to explore the relationship between mood, attentional bias measures and drinking-related variables. The results of this study are discussed in detail in relation to the theoretical and clinical implications and future research is suggested.

Keywords: attentional bias, alcohol, naturalistic setting, fixed eye tracker, head mounted eye tracker, visual probe task, craving

Acknowledgements

I am indebted to those individuals who participated in this study. This study would not have been possible without them giving up their time so readily.

I would like to thank my supervisors Professor Matt Field, Dr Abi Rose and Susan Mitzman for sharing their expertise in this area and for their support, guidance and constant understanding throughout the study. A special thank you goes to Dr Joanne Dickson for her role as advisor on this study; and for her continued support and guidance.

I would also like to thank my family and friends who have supported me throughout the whole process, especially during the latter stages when it was difficult to see the light at the end of the tunnel. A special thank you goes to Dr Jim Williams for his ongoing encouragement and belief in my abilities, and to Dr Sarah Hanmer and Dr Miguel Montenegro for so generously giving their time to proof read this document.

Finally, a very special thank you goes to my parents, Michael and Brenda Dutton, and my fiancé Dan Barker, who have provided me with strength, love, encouragement and unending support. They have maintained hope and belief in me throughout the good and the bad days. I will be forever grateful.

Contents

List of Figures and Tables

List of Appendices

Chapter 1: Introduction

There is a large amount of literature that provides evidence for the role of attentional bias (AB) in addictive behaviours (Field & Cox, 2008). However, to date, there has been no evidence of any research in the field of alcohol addiction that investigates if traditionally used laboratory-based measures of AB correspond to more naturalistic methods of measuring AB in real-world settings. Therefore, this study aimed to fill the gap in the literature.

This chapter will begin by discussing alcohol in the context of today's society and consider definitions of alcohol use. It will go on to consider the role of implicit cognitions in addiction research, specifically AB. The chapter will present theoretical models relating to the role of AB in addiction. The evidence for the role of AB in alcohol addiction will be considered including discussion regarding the measurement of AB, the impact of quantity and frequency of substance use on AB and if AB predicts prospective use and relapse. The next section moves on to consider the relationship between craving and AB which includes discussion of the impact of AB manipulation and modification before moving on to considering factors that might impact upon AB such as impulsivity, impaired inhibitory control and stress. The next section considers the role of substance-related expectancies. Following on, the literature relating to AB and clinical interventions, specifically mindfulness-based interventions, will be considered. Finally, the aims and hypotheses for the present study are presented.

A literature search was conducted by searching a number of electronic databases including MEDLINE, PsycINFO, Scopus and Web of Science for studies published in the English language. An extensive review on the development, causes

and consequences of AB in addictive behaviours has previously been conducted by Field and Cox (2008). The aim of the current search was to review developments in the literature since this time (i.e. 2008-2014), whilst providing an overall summary of the relevant literature in relation to AB in alcohol addiction. Two keyword categories were used relating to AB, including measures of AB, and alcohol use (see Appendix 1). The abstracts were inspected and relevant articles obtained (see Figure 1.1).

Studies were selected based on pre-determined criteria. Papers were included if they investigated an adult population (aged 18 years and above), focused on alcohol addiction, and were published between 2008 and 2014. Papers were excluded if they looked at addiction to substances other than alcohol, if the population under investigation were under the age of 18 years and if the paper was deemed to be of poor quality. The Critical Appraisal Skills Programme quality checklists (Critical Appraisal Skills Programme, 2014) were referred to in order to aid the assessment of the quality of the papers selected, with specific focus on identifying papers for exclusion that had major methodological or statistical flaws. The final selection of articles were checked for citations to other relevant articles that were obtained and included if they met the criteria described above. Papers published prior to 2008 were included from this sub-selection if they were deemed to be particularly pertinent to the understanding of the research area and theory.

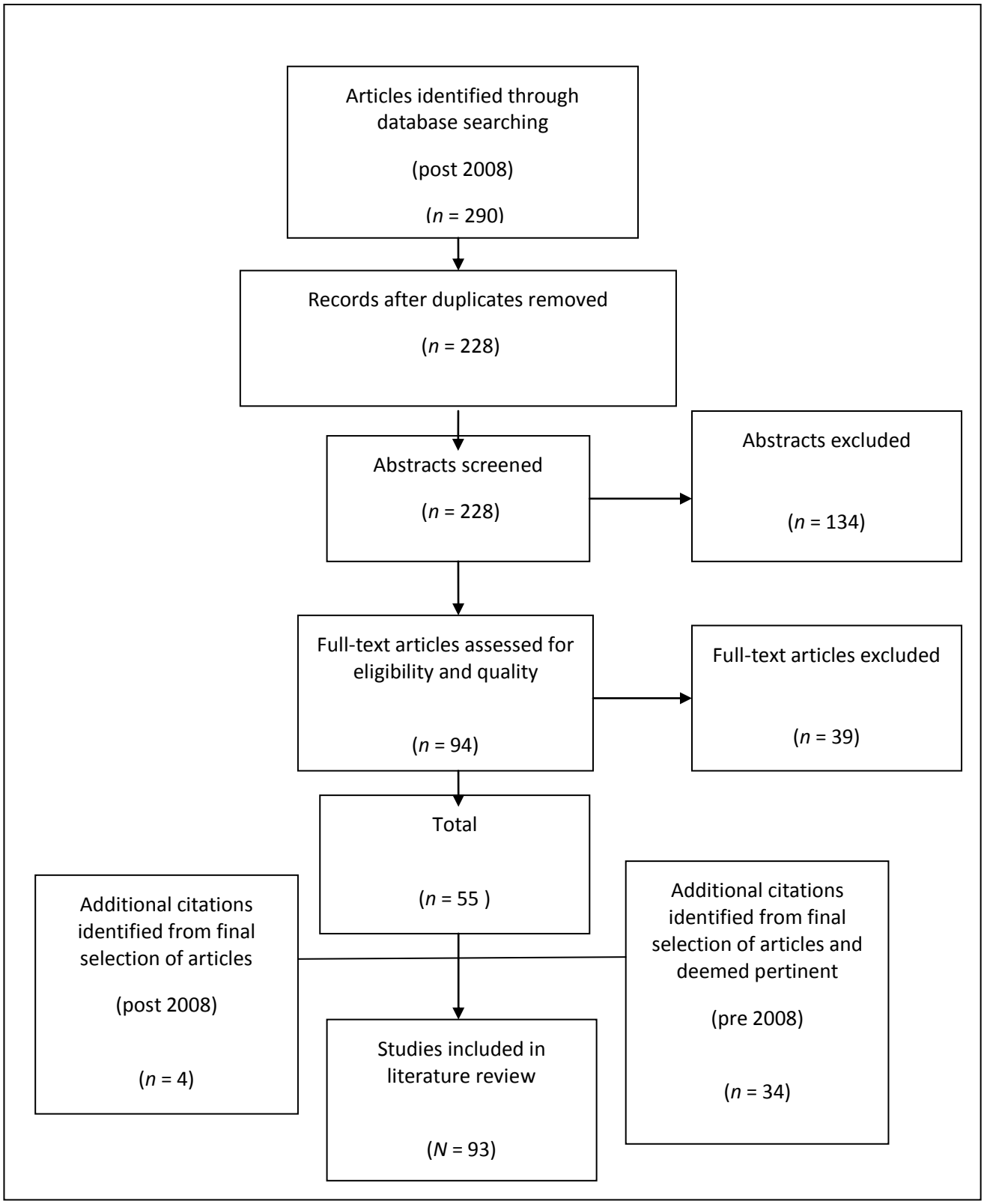

Figure 1.1. Flow diagram illustrating the literature selection process.

1.1 The Social and Financial Costs of Alcohol-Related Morbidity

Alcohol has been identified as the world's favourite drug (Heather, Peters, & Stockwell, 2001). In 2010, the World Health Organisation (WHO) reported that alcohol was a significant contributor to the "global burden of disease", with alcohol listed as the third leading risk factor for premature deaths and disabilities worldwide.

Fifty years ago the United Kingdom (UK) had one of the lowest drinking levels in Europe, it is now one of the few European countries whose consumption has increased over that period and, over the last decade, there has been increasing concern regarding the UK's 'alcohol culture' (The Department of Health [DOH], 2012). According to the National Institute for Health and Clinical Excellence (NICE, 2011) in England alone, 4% of people aged between 16 and 65 are reported to be alcohol dependent and 24% of the English population consume alcohol in a way that is potentially, or actually, harmful to their health or wellbeing. Health inequalities are particularly evident, with alcohol-related death rates about 45% higher in areas of high deprivation (DOH, 2007).

There is growing concern regarding the cost of the UK's 'alcohol culture' on the nation's economy and health. The Government's Alcohol Strategy (DOH, 2012) stated there were 1.2 million alcohol-related hospital admissions; and in 2010/11, and in 2012, in Liverpool alone, there were 14,548 reported hospital stays for alcohol-related harm (DOH, 2012). The estimated financial burden of alcohol misuse in the NHS was approximately £2.7 billion (DOH, 2011); however this does not include the social and financial implications of alcohol with respect to the criminal systems and social care.

The government has begun to respond to these growing concerns with numerous policies and guidelines including the Harm Reduction Strategy for

England (DOH, 2004), the Government's Alcohol Strategy (DOH, 2012), and guidance on the commissioning of interventions to reduce alcohol-related harm (DOH, 2009a, 2009b). However, in order to inform these local and national policies it is crucial the processes and mechanisms that contribute to the development of an alcohol use disorder are understood.

1.2 Definitions of Alcohol Problems

Addiction is a term used to describe a person's physical and psychological dependency on a behaviour (Albery, Sharma, Niazi, & Moss, 2006). Addiction can be characterised by a number of key features including; a strong desire to participate in a particular behaviour, an impaired capacity to control the behaviour, discomfort or distress when the behaviour is prevented from occurring either temporarily, or permanently, and reoccurrence of the behaviour despite evidence the behaviour is associated with physical and psychological harm (West, 2006).

The disease perspective of 'alcoholism' predominated thinking for many years (Jellinek, 1960) differentiating 'alcoholics', who were seen as being sick and powerless in their ability to overcome their 'battle' with alcohol, in contrast to those who had the ability to drink in moderation. Such thinking was fundamental to alcohol treatments such as the 12-step program (Alcoholics Anonymous, 1979), which considered admitting powerlessness and remaining abstinent as being key to treatment of the 'illness'. However, with further developments in the UK, drinking began to be conceptualised as a learnt behaviour based on social learning theory (Bandura, 1977); a behaviour that should be understood in terms of the function it serves (Heather & Robertson, 1997).

The World Health Organisation (WHO) International Classification of Diseases (ICD-10; WHO, 1992) classifies alcohol addiction as either acute intoxication or, harmful or dependent drinking. The Diagnostic and Statistical Manual for Mental Disorders (DSM-5; American Psychiatric Association [APA], 2013) has recently integrated the DSM–IV (APA, 2000) classifications of alcohol abuse and alcohol dependence into a single disorder, alcohol use disorder, with mild, moderate, and severe sub-classifications (Appendix 2). These medical diagnostic systems define dependence as a cluster of behavioural, cognitive and physiological phenomena that develop after repeated use of a substance. Dependency phenomena typically includes increases in quantity or duration of use, desire to control, or unsuccessful attempts to cut down consumption, an increase in tolerance, prioritising alcohol over and above other obligations and activities, continuing to use alcohol despite knowledge of its harmful consequences and withdrawal once the substance use has been discontinued. The new DSM-5 (APA, 2013) now recognises craving, or a strong desire or urge to use alcohol, as one of the key features of alcohol use disorder.

1.3 Cognition and Addiction

The literature regarding alcohol and addiction has developed, and expanded, over the past sixty years. It has taken our understanding of the development and maintenance of addiction away from the concept of alcohol addiction as a 'disease' (Jellinek, 1960).

Researchers have been applying techniques from experimental psychology and the neurosciences to examine the cognitive processes involved in addiction

(Munafò & Albery, 2006; Wiers & Stacy, 2006). Experimental cognitive psychology distinguishes between two types of cognitive processes; implicit and explicit cognitions (Munafò & Albery, 2006). Explicit cognitions are defined as non-automatic processes and are characterised by the need for, and use of, more cognitive effort. Explicit processes are said to be controllable, modifiable, relatively slow acting and available to conscious introspection (Munafò & Albery, 2006; Rooke, Hine, & Thorsteinsson, 2008). In contrast, implicit cognitions are automatic processes which operate spontaneously, are fast acting and occur without the need for deliberation, reflection, intention or awareness (Stacy & Wiers, 2010).

There is evidence implicit cognitions play a significant role in addiction. Rooke and colleagues (2008) conducted a meta-analysis of 89 effect sizes based on the responses of 19,193 participants to estimate the magnitude of relationship between substance-related implicit cognitions, and the use of illegal and legal substances. They found a medium effect size of .31. This meta-analysis provides evidence of the value of research related to implicit processes in addiction.

1.4 Attentional Bias

There is a considerable body of research providing evidence that substance use and dependence are characterised by implicit cognitive processes. AB has been found to be particularly pertinent in the development and maintenance of addictive behaviours (Field & Cox, 2008; Stacy & Wiers, 2010). AB refers to the tendency for particular stimuli to capture, and hold, attention. Thus, in alcohol addiction, this refers specifically to the tendency for alcohol-related stimuli (e.g. beer bottles,

images of alcoholic beverages etc.) to capture and hold attention (Stacy & Wiers, 2010).

Over the past few years a substantial body of evidence has been growing of AB for alcohol-related stimuli in a variety of populations. People who are dependent on alcohol and heavy social drinkers, but not light social drinkers demonstrate AB for alcohol-related stimuli (Bruce & Jones, 2004; Cox, Fadardi, & Pothos, 2006; Field, Mogg, Zetteler, & Bradley, 2004; Klein, Nelson, & Anker, 2013; Sharma, Albery, & Cook, 2001; Stormark, Laberg, Nordby, & Hugdahl, 2000; Townshend & Duka, 2001). AB has also been found to be present in heavy drinkers relative to abstainers (Field & Wiers, 2012).

Some research has indicated that AB predicts alcohol consumption in heavy drinkers (Cox, Pothos, & Hosier, 2007; Fadardi & Cox, 2008); and there is further evidence of a direct casual effect of AB on alcohol consumption (Field & Eastwood, 2005), however, causality has not been replicated in other studies (Field et al., 2007; Schoenmakers, Wiers, Jones, Bruce, & Jansen, 2007). Field and Duka (2002) suggest AB may either contribute to heavy drinking, or may occur as a consequence of heavy drinking. More recently, it has been suggested AB may possibly prelude, or follow, heavy substance use or may play a role in the acceleration to problematic use (Field & Cox, 2008). It has also been demonstrated that the magnitude of AB is proportional to the amount of alcohol people habitually consume (Cox, Fadardi, Intriligator, & Klinger, 2014).

Other studies have looked at AB in people who are in treatment for alcohol addiction and evidence for overt attentional avoidance of alcohol stimuli has been found. For example, some studies have suggested alcohol abusers in treatment will

avoid attending to alcohol-related stimuli when conditions allow them to control their attention (Stormark, Field, Hhugdahl, & Horowitz, 1997; Townshend & Duka, 2007). Klein and colleagues (2013) found that in individuals attending a residential treatment for alcohol dependence, alcohol AB lessened over repeated presentations of alcohol-related stimuli. Furthermore, other studies have indicated that avoidance of alcohol-related stimuli increases during the early stages of abstinence in alcohol dependent patients (Vollstädt-Klein, Loeber, Von der Goltz, Mann, & Kiefer, 2009).

The available evidence suggests AB is an important feature of alcohol use and dependence, and worthy of further exploration.

1.5 Theoretical Background

We will now review the main theoretical models that consider the role of AB in addictive behaviour.

The most dominant models within addiction research are dual-process models. Common to all dual-process models is the theory that there are at least two independent systems involved in the development of addictive behaviour, implicit cognitions and explicit processes (Munafo & Albery, 2006). The dual-process models (Stacy & Weirs, 2010) suggest that repeated substance use leads to an increase in automatic appetitive processing of substance-related stimuli. These automatic processes include AB directed towards substance-related stimuli.

Cue reactivity research into substance users responses to substance-related cues (stimuli) suggest these responses are conditioned. It is hypothesised AB develops as a consequence of classical conditioning: specifically, repeated pairings

of substance-related cues (conditioned stimuli) and the rewarding effects of those drugs (unconditioned stimuli) leads to conditioned responses when exposed to substance-related cues. These conditioned responses include attentional orientating towards the cue (AB), increased subjective craving, physiological arousal, and substance-seeking behaviours (Field & Cox, 2008; Field, Marhe, & Franken, 2014; Franken, 2003).

Other models of addiction describe neuroadaptations and psychological changes that underlie the shift from recreational use to misuse and describe a central role for AB processes. Robinson and Berridge (1993, 2008) proposed the theory of incentive-sensitisation which incorporates the concept of conditioned responses. They suggest repeated administration of any substance of abuse produces a neural response in the sub-cortical structures associated with the reward mechanisms and associated learning (through classical conditioning). This results in the release of dopamine (a neurotransmitter that controls the brain's reward and pleasure centres), and this response gradually becomes sensitised each time the substance is taken resulting in strong cravings. The substance comes to be perceived as particularly salient which leads to an increase in the motivational 'pull' of any substance-related cues (e.g. the sight and smell of alcoholic drinks). Obtaining and administering the substance then becomes an important goal for the individual. The incentive-sensitisation theory suggests that subjective craving and AB for substance-related cues are associated. Both processes are seen as emotional and cognitive outputs of the sensitized dopaminergic system that motivates substance-seeking behaviours (Robinson & Berridge, 1993, 2008).

Franken (2003) further extended the incentive-sensitisation model by proposing a neurobiological cognitive model. It was hypothesised subjective craving

and AB have a mutual excitatory relationship with each other, and that a substance-related cue would produce an increase in dopamine levels in the cortico-striatal circuit (forebrain circuits involved in motivational processes). This theory proposes that increases in levels of dopamine results in an attentional shift towards the substance-related cue. This results in increases in subjective craving that, in turn, increases the attention 'grabbing' properties of the substance-related cue, this process continues until the substance is sought out and taken. In summary, this model proposes that the motivational system becomes overactive as a consequence of repetitive substance use. This repetitive use sensitises the mesolimbic reward system to the point that the perception (not only the use) of the substance and substance-related cues become salient; and therefore attention is automatically orientated to these stimuli (i.e. AB for substance-related cues).

Another model proposed by Ryan (2002) argued "cue reactivity and the experience of craving are meaningfully related to perceptual and cognitive processes that occur before, during and after cue exposure" (Ryan, 2002, p.68). Ryan's model suggests substance-related stimuli receive preferential attentional processing. This preferential processing impacts upon subjective craving in response to these cues. This model hypothesises a reciprocal relationship between subjective craving and AB for substance-related cues with an elevation in craving increasing the attention that is paid to substance-related cues and vice versa.

Field and Cox (2008) further developed these models by theorising that AB was moderated by substance user's impulsivity, impaired inhibitory control and conscious attempts to suppress craving and avoid attending to substance-related cues. They argue that through classical conditioning substance-related stimuli elicit an expectation of substance availability which is termed 'expectancy'. Expectancy

leads the individual to experience subjective craving and AB for substance-related cues. Craving and AB are seen as having a mutual excitatory relationship. They propose that due to the key role of expectancy, craving and AB will be reduced when the drug is perceived as not available (e.g. in treatment). Any attempts to suppress craving and AB may be partially successful or may increase the strength of craving and AB. Their theory suggests impulsive individuals and/or those with compromised inhibitory control should have larger AB and should also experience higher levels of subjective craving.

The theories of Franken (2003), Ryan (2002) and Field and Cox (2008) suggest AB for substance-related cues are associated with craving at that moment in time. Once established, AB may increase the likelihood of alcohol self-administration given an individual who is repeatedly distracted by alcohol cues in their environment would be more likely to experience alcohol craving and more likely to act on that craving and seek out alcohol (Field & Wiers, 2012; Field & Franken, 2014).

Another pertinent model in relation to the role of AB is Kavanagh, Andrade, and May's (2005) elaborated intrusion theory of desire. This general model of subjective motivational emphasises the importance of craving in relation to AB. This model posits that subjective substance craving can initially be experienced as an intrusion caused by internal states or an external cue. Once the substance-user becomes aware of the feelings of craving he/she elaborates on it (e.g. ruminating on the craving or maintaining attentional focus on the external cue; Field & Cox, 2008). This increases the strength of the craving. This theory suggests that the relationship between attentional processing of substance-related cues has a bidirectional causal relationship between craving and AB for substance-related cues.

Cox and Klinger's (1998, 2004) theory of current concerns also focuses on motivational states and its influence on attentional processing. This theory describes the concept of a 'current concern'. This is defined as an individual's motivational state which occurs at the stage between being focused on following a goal and the point of either achieving or giving up on achieving the goal. It is proposed that during the search for the desired goal the individual's motivational state will bias certain cognitive processes. These cognitive processes then become focused on cues relating to the goal. This keeps the individual focused on achieving their goal by altering their automatic responses to stimuli that are associated with the goal. It is theorised that in addictive behaviour the goal of using a substance explains the reason why individuals are more likely to attend to things in their environment that are related to achieving their goal e.g. beer bottles. This goal leads them to become easily distracted by these substance-related cues which results in changes in their automatic attentional processing (i.e. AB).

In summary, there are several theoretical models that propose a role for AB in substance use. Cue reactivity research suggests substance users responses to substance related cues are conditioned. Later models expand on this idea and suggest neuroadaptations occur as a result of these conditioned responses (Franken, 2003; Robinson & Berridge, 1993, 2008). The importance of craving is also highlighted, with theories suggesting a mutual excitatory relationship between AB and craving (Field & Franken, 2014; Field & Wiers, 2012). It has also been suggested that AB may also be moderated by substance user's impulsivity and impaired inhibitory control (Field & Cox, 2008). Other models also highlight the importance of motivational states in relation to craving and attentional bias (Cox & Klinger, 1998,

2004; Kavanagh et al., 2005). We will now consider the current evidence for AB in alcohol addiction.

1.6 Evidence for Attentional Bias in Addictive Behaviours

1.6.1 Measuring attentional bias in alcohol users and abusers.

Researchers have used a variety of measures to investigate implicit processes. These measures frequently rely on alternative responses (e.g. reaction times) to make inferences about underlying cognitive processes. The value of implicit measures is that they capture spontaneous processes that may operate when the addictive behaviour is triggered (Stacy & Wiers, 2010). Implicit measures of AB have been highly scrutinised due to the ambiguity of the sub-process that they may measure (Field & Cox, 2008). The attentional system is not unitary and different cognitive mechanisms may underlie the shifting and disengagement of attention (Allport, 1989; LaBerge, 1995).

AB can be measured directly (eye movement) or inferred with responses such as reaction times. AB measures most frequently assess two related components of AB; initial orientation to stimuli and difficulty in disengaging from stimuli. The two most commonly used methods to assess biases in attention are the modified Stroop task and the visual probe task. Full descriptions of the Stroop and visual probe tasks and in-depth discussions of their strengths, weaknesses and underlying psychological processes, can be found elsewhere (Field & Cox, 2008; Field, Munafo, & Franken, 2009).

During the visual probe task (e.g. Ehrman et al., 2002) a substance-related cue (e.g. an image) and a control cue are presented at the same time on a computer screen before both disappearing. A visual probe then appears in place of one of the two visual cues. Individuals are asked to respond rapidly when they see the probe. How quickly individuals respond to the presentation of probes that replace substance-related cues is compared to how quickly they respond to probes replacing neutral cues. It is suggested that individuals respond quicker to probes presented in the area of the computer screen they are focused on (Posner, Snyder, & Davidson, 1980). When individuals respond quicker to probes that replace substance-related cues compared to probes replacing control cues AB for substance-related cues is indicated. When calculated in this way AB relates to the reaction time of individuals to substance-related cues. An AB index is computed by deducting reaction times to probes replacing substance-related cues from reaction times to probes replacing neutral cues.

The reaction time measure indicates which cue an individual's attention was focused on at the time the cue was removed from the visual display. It has been suggested that by presenting substance-related cues for different periods of time (known as the stimulus onset asynchrony [SOA]) it is possible to look at different attentional processes e.g. initial orientation of attention compared to loss of attentional focus (Bradley, Field, Mogg, & De Houwer, 2004). A variety of cognitive processes are thought to influence these different aspects of attention (Field & Cox, 2008). It is suggested that a quick and automatic bias in attentional shift is measured with short SOA's and a bias in the loss of attentional focus is measured through the use of longer SOA's. It is proposed that shorter SOA's enable individuals to move their attention once between the cues. This indicates that the reaction time index of

AB using short SOA's may be a measurement of biases in initial orientation of attention. SOA's of a greater duration may enable individuals to make several switches of attention between different cues. In this instance, the AB index is likely to be measuring a bias in the maintenance or loss of attentional focus.

Studies using the visual probe task have revealed an interesting discrepancy between heavy drinkers who are not seeking treatment, and alcoholics recruited from treatment settings. Compared to light social drinkers, heavy drinkers recruited from local communities and university campuses show AB for alcohol-related cues, which is particularly apparent when picture pairs are presented for longer stimulus durations (e.g. 500-2,000ms; Field, Mogg, Zetteler, & Bradley, 2004; Miller & Fillmore, 2010; Townsend & Duka, 2001) but not for shorter durations (e.g. 200ms; Field et al., 2004). Individuals with alcohol dependence, who are tested during or shortly after treatment, show a different pattern compared to light social drinker controls, they show AB for pictures presented for short exposure durations (50-100ms; Noel et al., 2006) but attentional avoidance when pictures are presented for 500ms (Noel et al., 2006; Stormark et al., 1997; Townsend & Duka, 2007). Vollstädt-Klein and colleagues (2009) reported a similar pattern of AB toward alcohol pictures (presented for 50ms) followed by attentional avoidance (of alcohol pictures presented for 500ms) in alcoholics. Finally, Loeber and colleagues (2009) also reported significant AB toward alcohol cues presented for 50ms in alcoholics; however, there was no control group within this study.

Field, Mogg, Mann, Bennett, and Bradley (2013) suggest the findings in abstinent alcoholics illustrate a "vigilance-avoidance" pattern of AB. That is, on the visual probe task, AB which is directed toward stimuli with high motivational salience presented for relatively short stimulus durations (e.g. 50-200ms) is assumed

to reflect rapid initial allocation of attention to stimuli; whereas subsequent attentional avoidance at longer stimulus durations may reflect strategic processes aimed at minimising subjective discomfort (Cisler & Koster, 2010). Townsend and Duka (2007) reported a negative relationship between craving and AB at 500ms on the visual probe task in alcoholic patients, which they hypothesise may reflect a strategy acquired during treatment, to direct attention away from alcohol cues to avoid temptation.

Fixed eye-tracking equipment (FET) has also been used in conjunction with the visual probe task (Field, Mogg, & Bradley, 2004). Eye movement measures have several advantages over other methods of measuring AB. They provide ecologically valid measures that closely follow, and are guided by shifts in selective attention (Jonides, 1981; Kowler, 1995). Previous studies utilising eye movement measures have measured the overall amount of time a participants gaze was directed to the substance-related and control pictures over the course of picture presentation on the visual probe task. This is known as 'dwell time', this represents the maintenance of attention. This method is commonly used to assess the duration of eye movement fixations to specific areas of interest. This 'dwell time' measure has been shown to have good concurrent validity with reaction time measures of AB on the visual probe task (Field, Mogg, & Bradley, 2004; Mogg, Bradley, Field, & De Houwer, 2003).

Recent research has explored the impact of stimuli complexity in the measurement of AB. Research utilising the visual probe task has suggested complex alcohol-related images may be less effective at capturing drinker's attention and may therefore result in less AB (Miller & Fillmore, 2010). Miller and Fillmore (2010) examined AB in a small sample of adult drinkers (N = 25) using two measures of AB, a visual probe task and an eye-tracking measure. The effect of image

complexity was examined by comparing AB to complex versus simple images. Complex images depicted real-life scenes involving alcohol (e.g. bar and party scenes with people consuming alcohol); whereas simple images depicted a single solitary image of an alcoholic beverage. Findings suggested drinkers displayed AB towards simple images as measured by both measures of AB. The authors suggest this may be due to the fact complex images depicting environmental settings introduced more non-alcohol related features that could compete for attention. However, these findings are difficult to generalise due to the small sample size.

Recently there has been debate regarding the internal reliability of both the modified Stroop and visual probe measures (Ataya et al., 2012a, 2012b; Field & Christiansen, 2012). In a re-analysis of seven different studies, Ataya and colleagues (2012a) found poor internal reliability of both measures. Field and Christiansen (2012) suggested the nature of the stimuli used is extremely variable across studies and non-individualised stimuli may not hold as much salience as individualised stimuli. Further research conducted by Christiansen and Bloor (2014) found reaction times to individualised alcohol-related words on a modified Stroop task were a significant predictor of drinking behaviour after controlling for demographics in a student population. They suggested that an individualised Stroop task may have good predictive reliability in heavy social drinkers and alcohol dependent individuals. Fridrici and colleagues (2013) also found non-dependent social drinkers were slowest to name alcohol-related words when they were based on personal drinking habits compared to non-specific alcohol-related stimuli, however, this was not evident within the alcohol-dependent sub-sample.

Ataya and colleagues (2012b) raised some interesting reflections with regards to the use of such laboratory based methods in measuring the complexity of 'real-

world phenomena'. They commented that the role of AB in alcohol addiction has been well established but stated that the challenge remained as to how best to measure this phenomenon.

Field and Christiansen (2012) and Ataya and colleagues (2012a) agree the poor reliability of the these two widely used measures may be due to the use of reaction time to infer AB. They suggest that this method may be 'inherently noisy' due to the multiple cognitive and motor processes involved (Ataya et al., 2012a). Research indicates eye movement measures of AB may have superior internal reliability and ecological validity, and need to be further explored (Ataya et al., 2012a; Field & Christiansen, 2012).

Recently, there have been further developments in the field of neurosciences in relation to methods of measuring implicit cognitive processes. This development in the literature has provided further evidence for the role of AB in addictive behaviour. Investigators have recently begun to study the neural substrates of AB using functional magnetic resonance imaging (fMRI), electroencephalography measures (EEG) and physiological signs. Garland, Franken, Sheetz, and Howard (2012) have reported that alcohol-related AB is associated with parasympathetically mediated heart rate variability and finger temperature. They suggested these responses reflected underlying neuro-cognitive processing associated with reward. A meta-analysis of the electrophysiological indices of biased cognitive processing of substance-related cues (Littel, Euser, Munafò, & Franken, 2012) indicated that enhanced electrophysiological processing of substance-related stimuli at the P300 and Slow Potential (SP) amplitudes (amplitudes associated with the recruitment of attentional resources to motivationally relevant stimuli), were found to be significantly larger for substance-related cues in substance abusers than controls.

Vollstadt-Klein and colleagues (2012) conducted an fMRI study investigating the association between cue reactivity and AB in 38 recently abstinent alcohol-dependent patients during the presentation of alcohol-related images. Their findings indicated the brain regions implicated in AB for alcohol-related cues included those involved in attentional processing (the anterior cingulate cortex and thalamus), areas of the cortico-striatal circuit related to motivational processes (prefrontal area, ventral and dorsal striatum) and regions involved in emotion processing (insula). The authors suggest a bi-directional relationship between the mesocorticolimbic reward system and AB for substance-related cues (Vollstadt-Klein et al., 2012). These findings have been supported elsewhere (Crunelle, Veltman, Booij, Emmerik-van Oortmerssen, & van den Brink, 2012) and support neurobiological theories proposed by Robinson and Berridge (1993, 2008) and Franken (2003).

Further studies have provided evidence of underlying neurocognitive mechanisms involved in AB processes. Gladwin, ter Mors-Schulte, Ridderinkhof, and Wiers (2013) conducted a study with 35 social drinkers and found activation of the medial parietal cortex (a region associated with automatic shifting of attention between stimulus) in social drinkers who were instructed to direct their attention towards alcohol-related cues compared to when they were asked to direct attention away for alcohol-related cues and towards non-alcohol related cues. Their results indicated that the medial parietal cortex activation was related to attentional control involving alcohol cues.

There is also evidence suggesting differential brain responses to alcohol cues across stages of alcohol dependence with controls and long-term abstainers demonstrating increased use of attention and cognitive control regions of the brain

(the dorsal anterior cingulate cortex, inferior parietal lobule and amygdala); whilst recent and long term abstainers show less limbic reactivity (emotional response) to alcohol cues compared to controls (Fryer et al., 2013).

The use of neurocognitive measures in AB research has provided further evidence supporting the importance of AB in understanding the development and maintenance of alcohol addiction. Furthermore, research suggests neurocognitive measures might be better predictors than self-report measures (Marhe, Luijten, & Franken, 2013). However, debate remains as to the most useful and accurate measurement of AB in relation to both clinical and research fields. The literature suggests that alternative methodologies need to be explored, the current study aims to explore the use of modern eye tracking technology as a measurement of AB in naturalistic environments and explore its relationship to more traditional laboratory-based measures.

1.6.2 Attentional bias and quantity and frequency of substance use.

The research literature has considered the impact of alcohol consumption on the process of AB. In Field and Cox's (2008) review they concluded the evidence suggests that amongst users of different substances, substance-related AB was directionally proportional to the quantity and frequency of the substance use. They suggested the results of studies with users of alcohol were consistent with the motivational model of substance use (Cox & Klinger, 1988, 2004) and the incentive-sensitisation model (Robinson & Berridge, 1993).

More recent studies have demonstrated AB in social drinkers persists under the influence of alcohol and this effect is demonstrated at blood alcohol levels above 80mg/100ml. Miller and Fillmore (2011) observed twenty adult social drinkers

performance on the visual probe task under the effects of three doses of alcohol (0.0 g/kg, 0.32 g/kg and 0.64g/kg). Results indicated that AB was observable even at levels where alcohol consumption was shown to disrupt oculomotor functions fundamental to visual search tasks.

However, Fernie, Christiansen, Cole, Rose, and Field (2012) found heavy drinkers' AB for alcohol cues was unaffected by alcohol administration, whereas in moderate drinkers AB was absent after placebo but present after administration of alcohol. Weafer and Fillmore (2013) also found differences between heavy and moderate drinkers. They compared twenty heavy drinkers and twenty moderate drinkers who completed a visual probe task in response to a placebo and two active doses of alcohol (0.45g/kg and 0.65g/kg). Results indicated heavy drinkers displayed significantly greater AB than moderate drinkers following placebo. However, heavy drinkers displayed a dose-dependent decrease in AB following alcohol, whereas no effect was seen in moderate drinkers. They suggest these findings may be explained in that once the effects of the alcohol dose has been experienced the drinkers' AB diminishes as the incentive salience of these cues are overcome by the dopaminergic rewarding effects of the drug once consumed. This indicates that alcohol administration satiates the motivation to drink in heavy drinkers.

A further study by Roberts and Fillmore (2014) investigated whether this satiety effect changes over time specifically in relation to the time course of the blood alcohol concentration (BAC). Participants completed the visual probe task at two time points after receiving 0.64g/kg and 0.0g/kg of alcohol, during separate sessions. Findings indicated that alcohol caused an immediate temporary reduction in AB amongst heavy drinkers following 0.64g/kg alcohol however, their AB returned to a magnitude comparable with their sober state. However, these changes

did not correspond with self-reported motivation to drink. Drinkers demonstrated an increase in motivation to drink following alcohol, which persisted after 0.0g/kg as BAC peaked and began to decline. These results suggest that as satiety fades individuals may again be compelled to drink due to an increase in AB.

In conclusion, the research to date indicates a relationship between the presence of AB to alcohol cues and the quantity and frequency of an individual's alcohol consumption. The current study will clarify whether there is a positive association between laboratory-based measures of AB and drinking habits but will also determine whether AB measured in a more naturalistic drinking environment correlates with usual drinking habits. The evidence to date has relied heavily upon individuals performance on the visual probe task utilising individuals reaction times to alcohol-related stimuli in order to infer attentional bias. The research has not fully explored if drinking habits correlate with other measurements that can be utilised to infer an individual's attention or inattention to alcohol-related stimuli e.g. how quickly an individual attends to alcohol-related stimuli compared to how long they spend looking at the alcohol-related cues. These additional measurements can be considered in more depth through the use of eye movement technology, therefore additional exploratory analysis will also be conducted to consider the relationships between these additional measurements of AB and drinking habits.

1.6.3 Attentional bias, prospective substance use and relapse.

Field and Cox's (2008) review describe several studies that investigate whether individual differences in AB predicts subsequent use, or the likelihood of relapse, amongst individuals attempting to abstain. They conclude that studies from clinical populations utilising the addiction Stroop task support the notion that the

processes that underlie this task play an important role in maintaining substance use in line with the incentive sensitisation and motivational models. The more recent developments in the literature, however, provide mixed evidence for this hypothesis (Christiansen, Schoenmakers, & Field, 2015; Field et al., 2014).

A study by Cox and colleagues (2007) into AB and relapse revealed that individual differences in AB for alcohol cues predicted future drinking behaviour in a sample of heavy drinkers who were not seeking treatment. Other studies also suggest that individuals with elevated AB would be less likely to maintain abstinence (Powell, Dawkins, West, Powell, & Pickering, 2010). However, several other studies utilising the visual probe or modified Stroop failed to find this relationship (Field et al., 2013; Marhe, Luijten, van de Wetering, Smits, & Franken, 2013).

More recently Garland, Franken, and Howard (2012) looked at a sample of alcohol-dependent patients in long-term residential treatment that had participated in mindfulness-orientated therapy or an addiction support group. They found those individuals with higher post-treatment alcohol related AB were more likely to relapse and tended to relapse sooner than their counterparts with lower levels of alcohol-related AB independent of treatment condition and after controlling for alcohol dependence severity. However, a more recent review of the literature suggests this is the only study that has reported an association between AB and relapse (Christiansen et al., 2015).

Christiansen and colleagues (2015) conducted a review investigating the predictive validity of AB as a predictor of relapse to substance use after treatment. They reviewed 28 articles (including articles relating to substances other than

alcohol). Their review highlighted a diverse range of findings in relation to the predictive validity of AB as a predictor of relapse. Some studies reported performance on the addiction Stroop predicted subsequent relapse in those attempting abstinence, but only one study reported that performance on the alcohol Stroop predicted reduction in drinking amongst problem drinkers who did not have a goal of abstinence (Cox et al., 2007). Three further studies failed to find this relationship and three additional studies found a relationship between Stroop interference and treatment outcome but in the opposite direction. Three of these studies included a visual probe task and found no significant relationship between this measure of AB and subsequent relapse. Only one paper found a significant relationship between AB and relapse (Garland, Franken, & Howard, 2012).

In conclusion, the current literature in relation to AB and relapse is inconsistent. On the one hand, some studies have suggested AB for alcohol cues predicts future drinking behaviour (Cox et al., 2007; Garland et al., 2010) whereas other studies have failed to find this relationship (Powell et al., 2010). Christiansen and colleagues (2015) review of the literature highlighted a diverse range of findings in relation to the predictive validity of AB in relation to relapse. They suggest many of the studies to date are underpowered and have methodological weaknesses. At present no firm conclusions can be drawn with regards the relationship between AB and relapse. We will now consider the relationship between AB and craving.

1.7 Attentional Bias and Craving

Craving can be defined as a "subjectively experienced motivational state that fluctuates over time" (Field, Munafo, & Franken, 2009, p.594). Some studies have

found that substance-related AB is associated with subjective craving for the substance as reported in Field and Cox's (2008) review, however they were unable to draw definitive conclusions about the circumstances under which the associations occurred. More recently Hobson, Bruce, and Butler (2013) found that processing biases in the orientation of attention to alcohol-related stimuli were demonstrated in higher craving compared to lower craving social users of alcohol. However, other studies have found no significant correlation between AB and subjective craving (Loeber et al., 2009). The following sections will review the most recent literature.

A meta-analysis of the relationship between AB and subjective craving (Field et al., 2009) suggested subjective craving was positively correlated with delayed disengagement of attention but not with initial orientating to alcohol-related stimuli. The authors evaluated the strength of the association between AB for substance-related cues and self-reported craving by performing a meta-analysis on 68 data sets. The primary analysis revealed a significant but weak (r =.19, p <.001) association between AB and craving. Further analysis revealed the association was larger for direct measures of attention (i.e. eye movement; r =.36, p <.001) than for indirect measures of AB (r =.18, p <.001); and was larger when craving strength was high. For studies looking only at alcohol the relationship was smaller than with other substances, and no differences were found between patients in treatment and those out of treatment. The association between craving and AB was larger when the strength of subjective craving was relatively high at the time of assessment. These results indicated that if AB was positively associated with craving then high levels of craving would show greater AB to substance cues. In summary, this meta-analysis suggests AB for substance-related cues is positively correlated with current levels of substance craving.

In a more recent review Field and colleagues (2014) surmise that there is a small, but robust, association between craving and AB and that the magnitude of the relationship increases when attention is measured directly (e.g. eye movements) rather than indirectly (e.g. Stroop task). These findings indicate AB appears to be related to the strength of craving. This leads to predictions that as craving fluctuates in individuals over time, AB will do the same. Townsend and Duka (2007) reported a negative relationship between craving and AB on cues presented for 500ms in alcoholic patients. This suggests the employment of strategies to direct attention away from alcohol cues in order to avoid temptation, in contrast to heavy drinkers not seeking treatment who appear to show a bias towards alcohol cues at similar durations (Miller & Fillmore, 2010).

1.7.1 Do increases in craving lead to increases in attentional bias?

Field and Cox (2008) described evidence suggesting the stimulation of a negative mood in heavy social drinkers increases subjective craving following the consumption of a priming dose of alcohol and presentation of alcohol-related cues. Utilising the visual probe task Field and Powell (2007) have provided evidence that increased craving for alcohol and AB for alcohol-related stimuli are found following exposure to a laboratory based stressor compared to a non-stressful condition.

Schoenmakers and Wiers (2010) further investigated the effects of high prime doses (up to 16 units) utilising the modified Flicker Paradigm (an AB task similar to the visual probe task) in an opportunistic sample of 72 social drinkers who had been drinking various amounts of alcohol. Results indicated craving rates increased in relation to the alcohol dose consumed. However, AB for alcohol-related cues was negatively predicted in relation to the dose of alcohol consumed in participants who had been binge drinking. AB for alcohol-related cues was found to decrease in

relation to the amount of alcohol consumed within a subgroup of people who had been drinking in excess of a binge. These findings are inconsistent with other findings (e.g. Schoenmakers, Wiers, & Field, 2008). One explanation is that once alcohol is consumed this leads to a decrease in incentive value of alcohol due to satiation effects.

An investigation by Weafer and Fillmore (2013) found that individuals classified as heavy drinkers displayed significantly larger AB compared to moderate drinkers following the consumption of a placebo dose of alcohol. The study compared participants performance on the visual probe task following consumption of two active doses of alcohol (0.45g/kg and 0.65g/kg) and a placebo dose. Heavy drinkers were found to display a dose-dependent decrease in AB following alcohol, whereas no effect was seen in moderate drinkers. They suggest their results may be explained by the fact that once the effects of the alcohol dose has been experienced, drinkers AB diminishes, as the incentive salience of these cues are overcome by the dopaminergic rewarding effects of the drug once consumed, indicating alcohol administration satiates the motivation to drink in heavy drinkers.

A further study by Roberts and Fillmore (2014) investigated whether this satiety effect changes over time specifically in relation to the time course of the BAC. Participants completed the visual-probe task at two time points after receiving 0.64g/kg and 0.0g/kg of alcohol during separate sessions. Their results indicated alcohol caused an immediate temporary reduction in AB amongst heavy drinkers following 0.64g/kg alcohol however, AB returned to a magnitude comparable with their sober state. However, these changes did not correspond with self-reported motivation to drink. Drinkers showed an increase in motivation to drink following alcohol that persisted after 0.0g/kg as BAC peaked and began to decline. These

results suggest that as satiety fades individuals may again be compelled to drink due to an increase in AB.

Field, Mogg, Mann, Bennett, and Bradley (2013) investigated this further and demonstrated that within a group of abstinent alcoholics higher levels of craving were associated with a larger AB on the visual probe task. The study comprised 28 alcoholic patients, who had commenced a day treatment program, and 26 social drinkers (controls) who completed an alcohol Stroop task, a visual probe task and self-report measures of craving and dependence. Results indicated abstinent alcoholics who had high self-reported craving showed greater AB for alcohol-related cues compared with social drinking controls or abstinent alcoholics with low self-reported craving. Individual differences in AB did not predict treatment compliance however severity of dependence and strength of craving were higher in those who dropped out of treatment versus those who completed treatment. The results suggest the importance of individual differences in craving when comparing AB in alcohol dependent individuals and controls.

In conclusion, the research to date indicates that individuals with high levels of craving demonstrate greater AB to substance-related cues. In addition, the magnitude of the relationship has been found to increase when attention is measured directly (e.g. eye movements) rather than indirectly (e.g. Stroop task). The current study will clarify if there is a positive relationship between an indirect measurement of AB utilising a laboratory task and craving but will also determine whether AB in a more naturalistic drinking environment utilising eye movement technology correlates with craving. The evidence to date suggests that delayed disengagement of attention but not initial orientating to alcohol-related stimuli may relate to craving. The use of eye tracking technology has not been applied to this area of research before therefore

further exploratory analysis will be conducted. For example, exploration of the relationship between craving and other direct eye movement measurements that infer AB such as time to initial orientation to alcohol cues compared to duration of time attending to alcohol cues will be considered. This may be important in our understanding of the relationship between craving and AB.

1.7.2 Effects of attentional bias manipulation on craving and substance use.

Field and Cox (2008) summarise evidence of a reciprocal causal relationship between subjective craving and AB (i.e. AB increases subjective craving). Field and Eastwood (2005) demonstrated an experimental manipulation increased participants' alcohol-related AB and also increased their subjective craving. These results indicated that even a brief manipulation increasing heavy drinkers' alcohol AB could have an immediate effect on craving and alcohol consumption. A meta-analysis of the modified Stroop task (Cox et al., 2006) found that studies employing substance-related manipulations such as deprivation produced a larger effect size suggesting that implicit cognitions (i.e. AB) may be associated with physiological aspects of substance use (i.e. craving).

The current evidence largely supports the theoretical arguments presented and described earlier. Several key models suggest that substance-related cues become more important as subjective craving increases (Cox & Klinger, 1988, 2004; Franken, 2003; Kavanagh et al., 2005). As a consequence of increased craving individuals then begin to attend to substance-related cues more readily resulting in greater increases in craving (Cox & Klinger, 1988, 2004; Franken, 2003; Kavanagh et al., 2005). These models therefore suggest that substance-related AB and craving

have a mutual excitatory impact upon each other. However, more recent developments in the area of AB modification training are starting to question these hypotheses.

1.7.2.1 Attentional bias modification.

AB modification (ABM) is an experimental procedure that can be adapted to produce either increases or decreases in AB. It has been applied to investigate the causal influence of AB for a range of disorder-related stimuli on subjective states or behaviour (Christiansen et al., 2015).

Various varieties of the visual probe test have been used to manipulate AB using a single session in experimental research (Field & Eastwood, 2005; Field et al., 2007; Schoenmakers et al., 2007). In an assessment version of the task the probe replaces the location previously occupied by a substance-related or neutral image. In the modification paradigm most, or all, probes replace the neutral images (avoid substance condition) or most probes replace the substance images (attend substance condition). Within the modification paradigm the positioning of the probe is altered in varying ways to teach individuals to either focus their attention away from or towards the place the drug-related cue was positioned. Trainers may therefore replace non-drug related control pictures with probes nearly 100% of the time in order to teach individuals to direct their attention away from drug-related stimuli. After several trials individuals begin to automatically move their attention away from drug-related cues enabling them to react more quickly to the probes when they are presented.

Results of some studies have shown that manipulation in attention can lead to changes in heavy drinkers' AB (Field & Eastwood, 2005; Field et al., 2007;

Schoenmakers et al., 2007). However, changes in AB to new (previously untrained images) has not been found which suggests these effects on AB may not be generalisable to other untrained stimuli (Field et al., 2007; Schoenmakers et al., 2007). Other studies have looked at multiple sessions of attentional training with alcohol-dependent patients. In the first randomised clinical trial Schoenmakers and colleagues (2010) used a version of the visual probe task. Within the study alcohol-dependent patients participated in attentional retraining over five sessions. During the sessions individuals were exposed to images presented for short (200ms) and long (500ms) periods of time. The results from this investigation demonstrated that when the stimuli was presented for 500ms individuals showed attentional avoidance for alcohol cues following attentional retraining. This change in individuals AB improved their ability to move their attention away from alcohol-related stimuli. In addition, the same effect was also seen when previously unseen stimuli was used. They also found that patients in the ABM group were discharged quicker from treatment compared to the control group.

The first laboratory study by Fadardi and Cox (2009) aimed to assess the effects of alcohol attention-control training on alcohol AB and alcohol consumption in both hazardous and harmful drinkers. Fadardi and Cox (2009) developed an Alcohol Attentional Control Training Program (AACTP) aimed at overcoming attentional distraction for alcohol-related stimuli. The program has several key components. First, using the alcohol Stroop test, it measures drinkers' alcohol AB, and it informs them of the results, and the meaning and consequences of their distraction. Second, it engages participants in their training with the AACTP which progresses through different levels of difficulty. Third, it aims to motivate participants by providing them with immediate feedback. Initial results have

indicated that from before, to after, the AACTP training participants showed a statistically significant reduction in their alcohol AB and alcohol consumption within both groups. They also found harmful drinkers had larger alcohol AB than hazardous or social drinkers; attentional training reduced hazardous and harmful drinkers' alcohol AB and harmful drinkers showed post training reductions in alcohol consumption. Harmful drinkers' improvements were maintained at three month follow-up.

A further internet-based study has been conducted for participants who wished to reduce their drinking (Wiers et al., 2015). Three hundred and fourteen participants completed the pre-test, of these, 136 participants completed the post-test after the last session. The first follow-up was one month after the post-test (n = 109), the second two months later (n = 87). Participants were randomly assigned to one of five conditions, either AACTP or one of three variants of approach-bias training re-training or sham training (control). At post-test there was a significant reduction in drinking across all conditions. At one and three months follow-up approach-bias re-training had a stronger effect than AACTP. However, the reduction in drinking in the approach bias re-training was not significantly different from the reduction in the sham-training group.

Recently, Christiansen and colleagues (2015) conducted a review investigating the predictive validity of AB of relapse to substance use after treatment and the efficacy of AB modification as an intervention to prevent relapse, or reduce substance use, among those with substance use disorder. They reviewed six laboratory-based studies employing a single session of ABM using a modified visual probe task. Results indicated that, with one exception, studies demonstrated a single session of ABM led to transient changes (increases or decreases) in AB at least for

pictorial stimuli that were used during ABM and on the AB task that was used to administer ABM. Effects of a single session did not alter attention for stimuli they were not trained for and effects did not generalise. Christiansen and colleagues (2015) also looked at six studies applying multiple sessions of ABM. They concluded the clinical potential of multiple sessions of ABM has been overemphasised when delivered in clinical or University settings.

Christiansen and colleagues (2015) argue there is no convincing evidence to date that AB measured in clinic settings predicts relapse or ABM administered in a clinical setting can reduce the risk of relapse. They suggest these results indicate AB does not have a causal influence on craving or substance use. Such findings are problematic for theoretical models that hypothesise a causal influence (Field & Cox, 2008; Franken, 2003). They suggest AB is an output of the current motivational state and that the strength of this motivational state is affected by environmental context and proximity to substance use. AB may therefore predict substance use in the short-term and ABM may reduce the risk of substance use if measured and administered in settings in which substance use normally occurs.

More recently studies have supported this notion and suggested ABM administered in a participants home environment may promote robust reductions in bias, craving and substance use (Mc Geary, Meadows, Amir, & Gibb, 2014). Mc Geary and colleagues (2014) examined the impact of a computer-delivered, home-based, alcohol-specific attention modification program (AMP). They recruited 41 heavy drinking college students who were randomly assigned to AMP or an attention control condition (ACC). Personalised stimuli were used in the AMP based upon the visual probe paradigm twice weekly for four weeks. Participants in the AMP condition reported decreased drinking. These results indicate that attentional training

in more naturalistic environments may have significant impacts upon the processes of AB, which in turn impacts upon drinking behaviour.

In conclusion, the results of some studies have shown that ABM approaches can lead to changes in heavy drinkers' AB through increasing an individual's ability to disengage their attention from alcohol-related cues (Field et al., 2007; Field & Eastwood, 2005; Schoenmakers et al., 2007; Wiers et al., 2015). However, the evidence to date has indicated that AB may not be generalisable to untrained stimuli therefore raising questions regarding the applicability of such training to real-world settings (Field et al., 2007; Schoenmakers et al., 2007). Other areas of the literature have further explored this and suggested that AB may predict substance use in the short-term and ABM approaches may reduce the risk of substance use if measured and administered in settings in which substance use normally occurs (Christiansen et al., 2015; Mc Geary et al., 2014). The results of such studies have indicated that attentional training in more naturalistic environments may have significant impacts upon the processes of AB, which in turn may impact upon drinking behaviour (Mc Geary et al., 2014).

1.8 Factors that Affect Attentional Bias

Field and Cox's (2008) review discussed different factors that may affect AB including impulsivity and impaired inhibitory control. This section will summarise the literature, and review recent developments within this area of research.

1.8.1 Impulsivity and impaired inhibitory control.

Impulsivity is a multidimensional trait that includes acting without thinking, seeking out exciting experiences and an inability to complete tasks (Lezak, 2004). As discussed earlier, neurobiological theories of addiction suggest a moderating role for impulsivity or weak executive control in the development of addiction (Robinson & Berridge, 1993, 2008). Inhibitory control can be defined as the ability to inhibit a motor response that has already been initiated (Miyake et al., 2000). Deficient inhibitory control is a component of impulsivity. Inhibitory control is crucial in controlling substance use by implementing the inhibition of inappropriate behaviour (Roberts & Fillmore, 2014).

Goldstein and Volkow (2002) and Jentsch and Taylor (1999) suggest the extent of executive dysfunction, or impulsivity, is directly related to the perceived salience of substance-related cues therefore individual differences in impulsivity should be correlated with individual differences in AB. Field and colleagues (2007) demonstrated that participants' alcohol consumption was positively correlated with AB for alcohol-related words (on the alcohol Stroop task) and with impulsive decision-making, particularly decisions in relation to obtaining alcohol. Participants' alcohol AB was also positively associated with impulsive decision-making.

One challenge in looking at the relationship between AB and impulsivity is the varying methods of measurement of impulsivity (e.g. trait [via self-report] or behavioural observations). Different methods may measure different aspects of impulsivity. A large meta-analysis of 13 research studies aimed to consider the relationship between different conceptualisations of impulsivity and substance-related AB (Coskunpinar & Cyders, 2013). Their findings suggested a small but

significant relationship between impulsivity and substance-related AB ($r = .20$, $p < 0.05$). They found behavioural impulsivity and substance-related AB had a stronger relationship compared with trait impulsivity and substance-related AB. Effect sizes were stronger in samples with more male than female participants. There was also significant heterogeneity in the relationships between substance-related AB and impulsivity. Coskunpinar and Cyders (2013) propose their results suggest AB is impacted by responses caused by dopamine and impulsivity which affects AB through classical conditioning.

More recently, Roberts, Miller, Weafer, and Fillmore (2014) examined the acute impairing effect of alcohol on inhibitory mechanisms of attentional control in a group of healthy social drinkers. AB was measured using the visual probe task and inhibitory control was assessed following a moderate dose of alcohol (0.64g/kg) and a placebo. Participants made more inhibitory failures following the alcohol dose compared to placebo, the relation of this effect to their drinking habits depended upon the level of the drinker's AB to alcohol-related stimuli. Amongst drinkers with higher AB, greater impairment of inhibitory control was associated with heavier drinking. Drinkers with little, or no, AB showed no relation between their sensitivity to the disinhibiting effects of alcohol and drinking habits. These findings indicate that heightened incentive-salience of alcohol cues and impaired attentional control can interactively contribute to excessive alcohol use.

Alcohol induced impairments in inhibitory control have been found to be related to alcohol-seeking behaviour (Weafer & Fillmore, 2008). Findings from a review by Field, Wiers, Christiansen, Fillmore, and Verster (2010) suggest that impaired inhibitory control and changes in automatic cognitions play a key role in the alcohol priming effect. Evidence suggests that impairment of inhibitory control is

seen after consumption of a moderate dose of alcohol; this impairment is associated with increased alcohol-seeking behaviour.

It is suggested that the relationship between impulsivity, executive dysfunction and alcohol use is bidirectional, with high levels of impulsivity and impaired executive function leading to heavy drinking. However, chronic heavy drinking may also lead to long-term increases in impulsivity and impairments in executive functioning (Field & Cox, 2008; Field & Wiers, 2012). There is evidence that cognitive control of substance-dependent people may be dysfunctional due to the long-term effects of alcohol consumption, thereby contributing to the lack of control over substance-related behaviours (Marhe, Luijten, & Franken, 2014).

Furthermore, research by Loeber and colleagues (2009) found that, on the visual probe task, there was a significant AB towards alcohol-associated pictures in patients who had been alcohol dependent for less than nine years, but not in patients with a longer duration of dependence. The two samples differed significantly with regards to attention and working memory functioning with patients dependent more than nine years showing greater impairment. However, when impairments were controlled for results indicated the group differences in AB were no longer significant suggesting that differences in drinking-related variables as well as cognitive functioning may modulate AB.

1.8.2 Attentional bias and stress.

The literature to date indicates that the stimulation of a negative mood in experimental conditions causes an increase in AB for alcohol-related stimuli within individuals who drink alcohol in order to manage stress (Field & Powell, 2007). One study looked at this phenomenon in social drinkers and considered the impact a

laboratory induced stressor may have on disengagement and initial orientating features of AB for alcohol-related stimuli (Field & Quigley, 2009). Field and Quigley (2009) found that after taking part in a task that increased stress levels individuals who stated they drank to cope with negative mood demonstrated greater AB to alcohol-related stimuli. These results suggest that delayed disengagement and initial orientation are both increased by stress and the experience of mild levels of stress in individuals described as social drinkers who drink to cope with negative mood causes changes in how they attend to and process alcohol-related stimuli (Field & Quigley, 2009).

A further study conducted by Forestell, Dickter, and Young (2012) indicated that 'escape drinking' (drinking as a means to escape distress) was associated with maintained AB for alcohol-cues. Their study comprised of 74 escape drinkers and 48 non-escape drinkers recruited from a student population who completed a visual probe task in which alcohol-related pictures contained humans interacting with alcohol-related cures (active) or alcohol cues alone (inactive); these were presented along with matched controls at either 500ms or 2000ms. Escape-drinkers displayed significantly stronger AB for alcohol-related cues than non-escape drinkers for inactive cues presented for 2000ms. These results suggest that escape drinking is associated with maintained AB for alcohol-related cues. Further research by Dickter, Forestell, Hammett, and Young (2014) indicated escape drinking was associated with more controlled AB to alcohol cues during a later stage in processing whereas alcohol dependence was associated with enhanced automatic AB in early processing.

In summary, the evidence suggests that negative mood increases AB for alcohol-related cues and increases in AB to alcohol-related cues is seen in individuals under stress. This evidence indicates an important relationship between

AB and stress or negative mood. Alcohol use disorders frequently co-occur with other psychological disorders such as anxiety or depression (Falk, Yi, & Hilton, 2008). A systematic review on attentional bias in individuals with alcohol use disorders examined how co-occurring psychopathologies were managed (Sinclair, Nausheen, Garner, & Baldwin, 2010). A total of 17 papers were included, thirteen gave minimal or no consideration for the impact of co-morbid psychopathology within their samples and only four contained some measure of current levels of mood or anxiety. This review indicated that despite the high prevalence of psychiatric co-morbidity it has not been consistently measured or described in experimental studies on alcohol-related attentional biases. These findings suggest the importance of ensuring valid and accurate data is collected on co-morbid psychopathologies in relation to attentional bias research. Based on the evidence discussed the current study aims to conduct some further exploratory analysis of the relationship between mood and drinking-related variables, as well as considering the relationships between mood and AB for alcohol related stimuli as measured by a laboratory based task and in a more naturalistic drinking environment.

1.9 Attentional Bias and Substance-Related Expectancies

Drug expectancy has been proposed as an important factor in the development of AB (Field & Cox, 2008). Evidence suggests substance users experience subjective craving and show AB for substance-paired cues when either they become aware of the predictive significance of a substance-paired cue, such that it elicits an expectancy of substance availability (Hogarth & Duka, 2006) or they are

exposed to a substance-paired cue in a context in which substance use is anticipated (Wertz & Sayette, 2001).

Field and Cox's (2008) proposed model suggests that drug expectancy is an important determinant of the magnitude of AB. Field and Cox (2008) propose that an expectation or expectancy to consume a substance is activated by the presentation of substance-related stimuli which brings about craving and AB. Through classical conditioning processes the substance-related stimuli will keep on triggering expectations of being able to use the substance, causing increases in subjective craving and increased AB for substance-related cues (Field & Cox, 2008).

Field and colleagues (2011) explored the role of drug expectancy in AB using an eye-tracking paradigm with social drinkers. They studied 58 social drinkers AB after being informed of the probability (100%, 50%, 0%) that they would receive beer at the end of the trial before their eye-movements towards alcohol-related cues were measured on a FET. Results indicated that heavy social drinkers showed an AB for alcohol-related cues regardless of alcohol expectancy. However, in light social drinkers, AB was only seen on 100% probability trials when alcohol was expected imminently. The results indicate that AB for alcohol-related cues is sensitive to the current expectancy of receiving alcohol in light social drinkers but occurs independently of the current level of alcohol expectancy in heavy drinkers.

Further research has also indicated that reward expectancy may enhance AB for all types of motivationally salient stimuli. Jones and colleagues (2012) studied 31 social drinkers who completed an eye-tracking task in which AB for alcohol and chocolate-related cues was assessed while the expectation of receiving alcohol and chocolate was manipulated on a trial-by-trial basis. Overall, participants showed AB

for alcohol and chocolate cues. These AB for reward cues were magnified when participants expected to receive alcohol and chocolate but the effects were not outcome specific; suggesting the anticipation of reward produces a general, rather than outcome-specific, enhancement of AB for reward-related stimuli.

In summary, the evidence to date suggests that drug expectancy has an important relationship with AB, however the research suggests that it may be dependent upon the level of alcohol individuals consume (Field et al., 2011). In addition, when expectancy is present it produces a generalised rather than outcome specific enhancement of AB (Jones et al., 2012). The next section will consider how the current literature on AB and alcohol might inform clinical intervention.

1.10 Attentional Bias and the Treatment of Addiction

The above research findings for AB have implications for our understanding of the development, prevention and treatment of addictive behaviours. Traditional intervention programs for the treatment of substance abuse have focused on changing substance use behaviours by targeting individuals' conscious attitudes, expectancies and beliefs. The focus has primarily been on changing explicit but not implicit cognitions. Due to the increasing body of evidence and understanding of the role AB has on alcohol-related behaviour this has led to a growing interest in different therapeutic approaches; two particular areas of interest have been ABM (discussed in detail above) and mindfulness-based therapeutic approaches.

1.10.1 Mindfulness and attentional bias.

AB refers to the tendency for particular stimuli to capture and hold attention (Stacy & Wiers, 2010). As discussed, the research evidence suggests that AB may be an integral component of alcohol dependence, therefore interventions affecting attentional processes and implicit cognitions may be promising treatment options. Mindfulness-based interventions (MBI's) have recently gained prominence for their efficacy in treating stress-related, bio-behavioural conditions (Kabat-Zinn, 2003). MBI's have been associated with reduced cognitive reactivity, decreased avoidance and rumination (Chiesa, Calati, & Serrati, 2011). It has also been suggested these changes may be as the result of improvements in cognitive abilities such as the development of attentional control (Chiesa et al., 2011; Lutz, Slagter, Dunne, & Davidson, 2008). Mindfulness practice involves repeated orienting of attention onto internal and external experiences within the present moment for example an object or action such as breathing, whilst 'accepting and letting go' of distracting thoughts, sensations and emotions (Kabat-Zinn, 2003).

Mindfulness training initially begins with practices that involve focused attention, key aspects include becoming aware when the mind wanders away from the sensation or stimuli and bringing back the attentional focus to the target stimuli (Chiesa et al., 2011). Lutz and colleagues (2008) suggest that the practice of mindfulness meditation requires the development of four key abilities; sustained attention to a particular stimuli, the ability to monitor and detect when the mind might be wandering, the ability to switch attention or disengage from distracting stimuli and the ability to redirect attention to the chosen stimuli known as selective attention. Garland, Froeliger, and Howard (2014) also describe the practice of mindfulness as involving focused attention but they also describe a secondary

process of open monitoring. Open monitoring is described as a state of meta-cognitive awareness, an awareness of the presence of changes in cognitive states or consciousness such as thoughts without engaging with, elaborating on or suppression of them. Garland and colleagues (2014) suggest that "both of these processes emphasise or differentially activate different cognitive capacities" (Garland et al., 2014, p.4) including attentional awareness and attentional re-orientating both important features of attentional control.

Trait mindfulness is the ability to attend to a present moment situation enabling increased awareness of automatic reactions which facilitates a non-reactive response to distressing thoughts, emotions and sensations (Chambers, Gullone, & Allen, 2009). Trait mindfulness demonstrates plasticity and it has been found to be enhanced by MBI's (Carmody & Baer, 2008; Chambers et al., 2009; Garland, 2011). Research has indicated that the practice of mindfulness can lead to significant increases in trait mindfulness (Garland, Gaylord, Boettiger, & Howard, 2010). There is evidence of positive relationships between trait mindfulness and self-reported attentional control, improved selective attention, decreased errors on sustained attention tasks and increase in attentional re-orientating capacity (Garland, 2011; Garland et al., 2014). These findings have important implications for the use of MBI's with individuals with AUD's, suggesting that individuals with high levels of trait mindfulness may have greater ability to control their attentional responses to substance-related cues for example being able to disengage their attention from alcohol related stimuli (Garland et al., 2014). In addition, it has been suggested that individuals being treated for alcohol dependency may be able to be trained to develop trait mindfulness through mindfulness practice, thus enabling them to

successfully regulate implicit processes such as AB through increased attentional control (Garland, 2011).

There is evidence supporting the idea MBI's impact the processes of AB. Garland and collegues (2010) studied 53 alcohol dependent adults randomised to mindfulness group training or support group only. Several measures were utilised including psycho-physiological cue-reactivity measures, alcohol AB and self-report measures. The results of this study indicated that lowered stress levels, a reduction in the suppression of thoughts, improved physiological recovery from alcohol stimuli and reduced AB to alcohol stimuli all occurred following mindfulness training. A further study looked at trait mindfulness in alcohol dependent individuals. Garland, Boettiger, and colleagues (2012) predicted that participants who demonstrated higher levels of trait mindfulness would demonstrate less AB in response to visual alcohol stimuli compared to those with low trait mindfulness. Their findings demonstrated that trait mindfulness predicted alcohol AB better than alcohol-related self efficacy, stress, pre-treatment level of alcohol use, craving or time they had been in treatment. The biggest single indicator of alcohol AB was found to be trait mindfulness. This study by Garland, Boettiger, and colleagues (2012) indicates that low trait mindfulness may be a risk factor for increased automatic addictive drives, craving and AB.

A review by Garland and colleagues (2014) suggested MBI's impact addiction by enhancing the regulation of a number of key cognitive processes in addition to attentional control. These processes include clarifying cognitive appraisals and altering negative emotions which in turn reduces perseverative cognitions and emotional arousal (Garland et al., 2014). As previously mentioned, mindfulness may also enhance awareness of meta-cognitive processes (higher-order

thinking that enables understanding, analysis, and control of one's cognitive processes; Garland, Boettiger et al., 2012; Garland et al., 2014; Kabat-Zinn, 2003) that regulate drug-use schema (Garland et al., 2014). The practice of mindfulness may also promote extinction learning (that is the gradual decrease in response to a conditioned stimulus that occurs when the stimulus is presented without reinforcement) to separate drug use triggers from conditioned appetitive responses (Garland, Franken & Howard, 2012; Garland et al., 2014). Mindfulness practice may also reduce cue-reactivity and increase individual's cognitive control over craving, calm physiological stress reactivity through the activation of the parasympathetic nervous system and restore the natural reward processing mechanisms (Garland, Franken, Sheetz, et al., 2012; Garland et al., 2014).

In summary, mindfulness training may strengthen the capacity to regulate attentional control in the face of conditioned stimuli associated with substance use, countering AB by refocusing and re-directing attention away from substance-related cues and toward innocuous stimuli. Thus, MBI's may help to mediate the impact of underlying implicit processes such as AB (Garland et al., 2014).

1.11 The Present Study

1.11.1 Overview and aims.

This chapter has aimed to summarise the substantial body of literature providing evidence for the role of AB in addictive behaviours, specifically in relation to alcohol use and AB for alcohol-related stimuli across both clinical and non-clinical populations. The literature to date has demonstrated AB is an important

factor in both the development and maintenance of alcohol addiction and several theories are proposed (Field & Cox, 2008; Franken, 2003; Robinson & Berridge, 1993, 2008; Stacy & Wiers, 2010). The literature has also highlighted the challenges of current methodological approaches to measuring AB including the reliability and ecological validity of laboratory based measures (Ataya et al., 2012a; Field & Christiansen, 2012). Additional factors have also been highlighted in the literature as being important in the development and maintenance of AB. These include craving (Field & Cox, 2008; Field et al., 2014; Field & Franken, 2014; Franken, 2003; Ryan, 2002), impulsivity and impaired inhibitory control (Field & Cox, 2008; Field et al., 2010), expectancy (Field & Cox, 2008; Field et al., 2011; Field & Wiers, 2012) and stress (Field & Quigley, 2009; Forestell, Dickter, & Young, 2012; Jones et al., 2012). It is beyond the scope of this study to address all of these areas therefore two specific primary hypotheses are being tested.

Within the current literature it has been demonstrated that the magnitude of AB is proportional to the amount of alcohol people habitually consume. The evidence suggests that amongst users of different substances, substance-related AB is directionally proportional to the quantity and frequency of the substance use (Cox et al., 2014; Field & Cox, 2008; Miller & Fillmore, 2011). This study aims to replicate previous studies by demonstrating that individuals with elevated levels of alcohol consumption will have increased AB to alcohol-related cues.

The evidence to date relating to the exploration of the role of AB in addictive behaviours has relied heavily upon traditionally used laboratory-based measures of AB. The two most widely used measures of AB have recently been criticised for demonstrating poor reliability (Ataya et al., 2012a; Field & Christiansen, 2012) and much debate remains as to the most useful and accurate measurement of AB in

relation to both clinical and research fields. In addition, there is no evidence of any research to date that has been found investigating if traditionally used laboratory-based measures of AB correspond with how people attend to alcohol stimuli in the real world. Investigating this is of importance as it will provide a real-life context in which to frame current and future directions of research with a view to developing effective treatment approaches. In addition, the literature suggests that alternative methodologies for measuring AB need to be explored and research has indicated that eye movement measures of AB may have superior internal reliability and ecological validity (Ataya et al., 2012a; Field & Christiansen, 2012). It is hoped this study will fill these gaps within the literature and aims to determine if there is any correlation between laboratory-based measures of AB, derived from a FET utilising the visual probe task, and a naturalistic method of measuring AB through head mounted eye tracking (HMET) equipment, thus, testing the ecological validity of past, present and future research.

Hypotheses

Two primary hypotheses will be tested:

Hypothesis 1 There will be a correlation between the two measures of AB.

Hypothesis 2 Participants who have elevated levels of alcohol consumption will have increased AB to alcohol-related cues.

Chapter 2: Method

This chapter provides an outline of the methodology used in this study. First, it outlines the participant characteristics and describes the sampling procedure. It then describes how the sample size for this study was determined before going on to describe the materials and measures used, the administration of measures and the testing procedure. Finally the data reduction techniques and data screening processes are described.

2.1 Participant Characteristics

2.1.1 Eligibility and exclusion criteria.

Participants were included if they were over the age of 18 and a fluent English speaker. Due to the use of eye tracking equipment, participants were only included if they had normal vision or wore corrective contact lenses. Participants were excluded if they were under the age of 18 or over the age of 30; had current or historical alcohol or drug dependence; were currently suffering from an acute mental or physical health problem; wore corrective eye glasses (the HMET manufacturer recommended this exclusion criteria as eye glasses impact upon the ability of the HMET to successfully track eye movements); and provided a breath alcohol reading above 0.0 mg/l on arrival at the experiment. The age range of 18-30 years was utilised; the lower age limit being the legal age limit for consuming alcohol in the UK, the upper limit was fixed as it is possible that alcohol-related AB will differ depending upon age, for example, older people are likely to have had a longer drinking history, which may have varying effects on alcohol-related expectancies.

2.1.2 Sample description.

This study was made up of a single non-clinical group recruited from the student population at the University of Liverpool (N = 43); 90.7% of participants described themselves as students (n = 39). The total sample comprised 7 males (16.3%) and 36 females (83.7%), with a mean age of 20.37 years (SD = 2.33), ranging from 18 to 28 years.

2.2 Sampling Procedure

Participants were selected through volunteer recruitment from the University of Liverpool student population. Students attending the undergraduate psychology course at the University of Liverpool are encouraged to take part in ongoing research within the department as part of the Experimental Psychology Research (EPR) scheme in which they receive points for participating which contribute towards their course modules. The study was advertised on the online EPR scheme website and students were able to express an interest in participating in the study either by e-mailing the researcher or by booking into one of the pre-allocated available time slots. Booking onto a time slot prompted an automated e-mail to the researcher to indicate interest in the study. Posters advertising the study were also placed on appropriate notice boards within the undergraduate psychology department, which included the researchers e-mail and telephone contact details (see Appendix 5). Finally, the study was also advertised on the online University of Liverpool internal announcements system.

Once individuals had contacted the researcher to express an interest in participating, the researcher responded via e-mail or telephone as preferred by the interested individual within 48 hours. When responding by e-mail the researcher provided further information regarding the study, including an attached copy of the participant information sheet (see Appendix 6 & 7). Once the individual had read the relevant information they were requested to contact the researcher if they still wished to participate. When the researcher responded to the interested individual by phone the researcher explained the rationale of the study and gave the opportunity for the interested individual to ask questions. The researcher would offer to post or e-mail a copy of the participant information sheet. If the individual continued to express interest in participating a mutually convenient time was arranged to participate.

Upon meeting the interested individual the researcher again went through the study rationale and gave the individual the opportunity to ask any further questions. If the individual agreed to take part they were asked to complete a consent form (see Appendix 7) and be breathalysed to ensure a reading of 0.0 mg/l. Data collection then commenced. For all participants, testing took place within the eye and bar laboratories within the Department of Psychology at the University of Liverpool. Participants who were undergraduate psychology course students received 5 EPR points on completion of participation. If they had already collected all their EPR points or if they were not an undergraduate psychology student they received £5 cash as compensation for their time in taking part in the study

A total of 114 individuals expressed an interest in the study. Figure 1.2 illustrates the flow of potential participants through the process of recruitment.

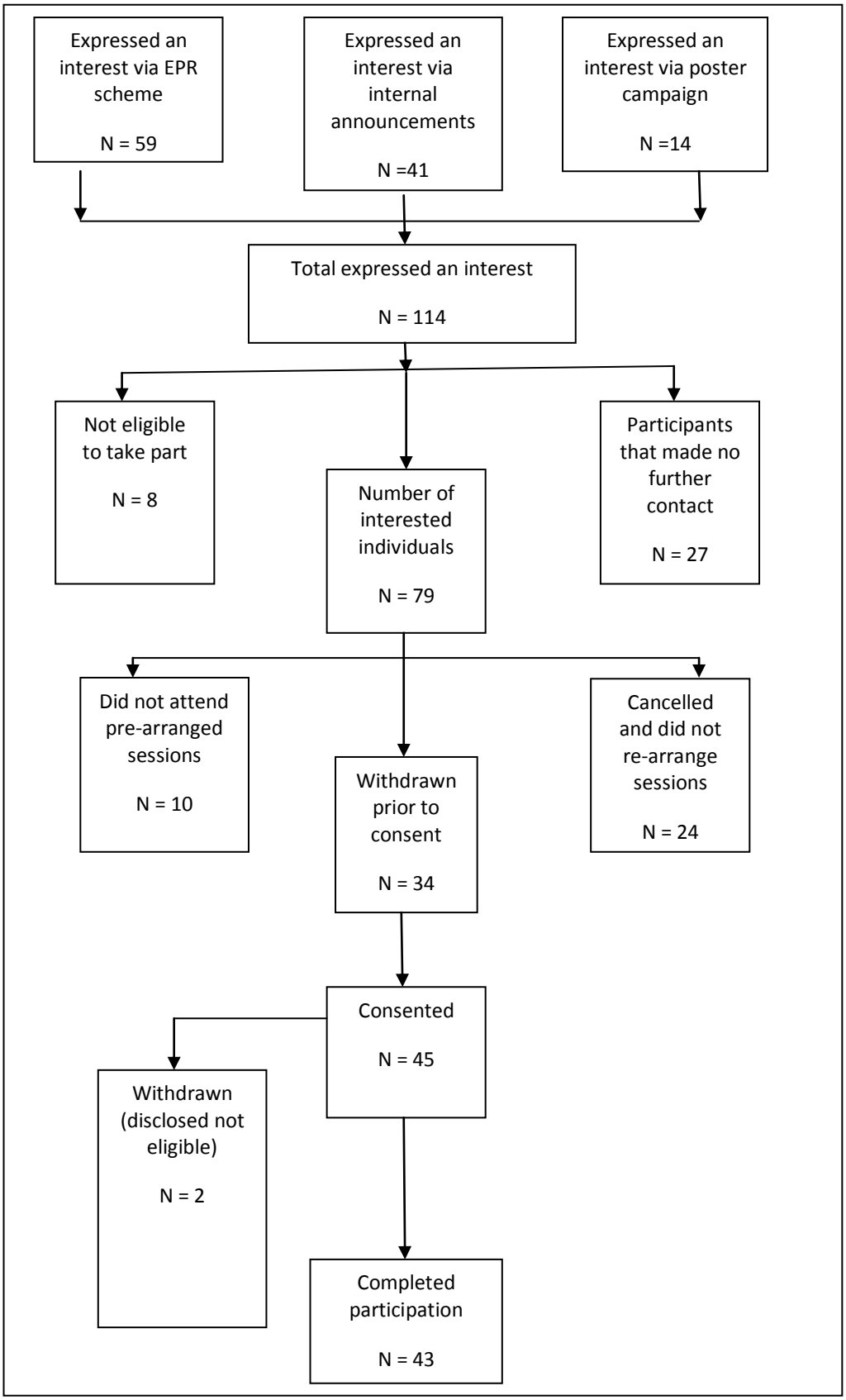

Figure 1.2. Flow of participants during recruitment.

2.2.1 Permission of ethics committee.

The research proposal for this study was submitted to the Doctorate in Clinical Psychology Research Review Committee and obtained approval following minor revisions. This study fell within a generic ethical approval already received from the University of Liverpool by Dr Abi Rose and Professor Matt Field for alcohol-related research under the University of Liverpool Ethics Committee (Code IPHS-1213-LB-024; see Appendix 3). Minor revisions of the proposal were requested of the researcher at a later date, which were approved. Copies of the correspondence concerning proposal approval can be found in Appendix 4.

2.2.1.1 Obtaining informed consent.

Informed consent must be obtained from each participant before data is collected and it is a key requirement of gaining ethical approval. Informed consent is important as it makes certain that participants fully comprehend their involvement and provides them with the opportunity to understand the processes of confidentiality, anonymity and the right to withdraw. An e-mailed version of the information sheet was sent prior to meeting the potential participant describing what participation would involve. A printed version of the information sheet was also given to participants on arrival as well as a verbal explanation upon meeting. Individuals were able to ask questions regarding participation at each stage of the recruitment process.

2.2.1.2 Confidentiality and risk.

Participants were told that if they experienced any distress whilst providing data or if any risks were identified, data collection would be stopped immediately.

Participants were informed in the participant information sheet that the information they provided would be kept confidential unless any immediate risks to either themselves or others were identified. If a participant were to disclose drug or alcohol dependence they would be advised to approach their G.P. They would also be signposted to relevant support services through the provision of telephone numbers and websites of useful organizations as documented in the participant debrief sheet. This did not occur with any of the participants. All participants were offered links to websites to psycho-educational material around alcohol and drug awareness within the participant debrief sheet (see Appendix 15). A plan was put in place if a participant presented as intoxicated including an initial risk assessment of the situation, contacting the named clinical supervisor for further direction, and ensuring the participants immediate safety. This did not arise during the course of this study.

2.2.1.3 Anonymity.

Green and Thorogood (2004) state that it is important that participants are reassured that the information they share is confidential and anonymised in line with ethical practices. These processes are necessary to ensure participants do not experience any negative effects as a consequence of their participation. It is also anticipated that the assurance of anonymity will reduce any worries or reluctance of participants to disclose information. In order to assure anonymity participants were given a unique ID number. The electronic data files were stored on a password protected University of Liverpool computer and the hard copies of all questionnaires were kept in a filing cabinet that was locked. The researcher agrees to abide by the *Data Protection Act* (1988) and The University of Liverpool's data storage guidelines.

2.2.2 Risk to the researcher.

It is important when undertaking research that any potential risk to the researcher is anticipated. In order to manage any potential risk to the researcher, staff within the department in which the study was conducted were informed of the researcher's location and time they were expected to finish. The researcher made sure they were familiar with the layout of the site. If they felt at risk from a participant whilst collecting data they were instructed to stop immediately. If an incident occurred that put the researcher at risk, they would discuss this with their research supervisors at the earliest possible opportunity. This did not arise during the course of this study.

2.3 Sample Size

The main area of interest was the relationship between two measures of AB. The first, derived from the Applied Science Laboratories (ASL)-6000 remote FET (sampling rate 120Hz) (v1.01; Applied Science Laboratories, Bedford, MA, USA). This conventional FET and measure of AB was used whilst people viewed images on a screen whilst completing the visual probe task. The second, derived from a more naturalistic measure of AB obtained using a HMET (Tobii Glasses Eye Tracker, Tobii Technology, Danderyd, Sweden), with which people viewed a natural bar scene. No previous research had utilised the HMET measure in relation to this, therefore Cohen's (1988) recommendations for behavioural sciences research was followed.

Cohen (1988) recommends that sufficient numbers of participants are recruited in order to detect medium effect sizes with a power of .80 and alpha of .05.

A one-tailed analysis was conducted due to the large body of research already establishing a robust demonstration of AB for alcohol cues in alcohol consumers. A one-tailed analysis also provided more power to detect an effect. For a one-tailed correlation analysis G*Power (Version 3.9.1; Faul, Erdfelder, Lang, & Buchner, 2007; Faul, Erdfelder, Buchner, & Lang, 2009) indicated that to detect a medium effect size of r = .30 with power set at 80% and significance level at .05, a total sample size of 64 would be required.

2.4 Measures and Materials

Several measures were used to investigate the key variables under analysis including two measures of AB (FET and HMET), measures relating to alcohol consumption and behaviour including craving and finally measures of current mood. This section will describe these measures in detail.

2.4.1 Screening questionnaire and demographic information.

Once the participants had consented to participate and had conducted the breathalyser test they were asked four screening questions by the researcher to ensure their eligibility in relation to the study exclusion/inclusion criteria (e.g. 'Do you have a current acute physical health problem?', 'Do you have current or historical drug or alcohol dependency?', 'Do you have a current acute mental health problem?'). Responses were 'yes' or 'no' in nature. In addition to this, demographic information was also collected in relation to age, gender, ethnicity, education, employment and smoking habits. A copy can be found in Appendix 8.

2.4.2 The Time Line Follow Back (TLFB) Method (Sobell et al., 1979).

The TLFB is a self-report measure that requires the person responding to provide estimates of their recent alcohol use through completion of a blank diary. Participants were given a blank diary covering the past two weeks and asked to record their daily alcohol consumption as precisely as possible. Participants had the option of completing the diary by indicting the number of units drunk in each day, or specifying the type of drink consumed, the drink brand or percentage alcohol content and amount consumed. If participants chose the latter the units of alcohol consumed each day was later computed by the researcher. The outcome variables collected were: total number of drinking days over two weeks, total units of alcohol consumed over two weeks, average units of alcohol per drinking day, total number of binge days (classified as six or more units for women or eight or more units for men) and total number of abstinent days.

Given that drinking is a complex behaviour and involves more than just quantity of alcohol consumed, additional questions were routinely included alongside this measure in relation to alcohol drinking and bingeing habits including; 'When you drink, how many units of alcohol do you drink per hour?', 'How many times have you been drunk in the previous six months?', 'On what percentage of drinking occasions do you get drunk?', 'At what age did you have your first alcoholic drink?', and 'At what age did you first begin to drink regularly?'. These questions were taken from the Alcohol Use Questionnaire, a validated measure of drinking habits and binge drinking which addresses issues such as drunkenness and speed of drinking (Mehrabian & Russell, 1978).

Drinking diaries are often used in research and clinical practice (Raistrick, Heather, & Godfrey, 2006). The TLFB demonstrates good reliability with test-retest

reliability coefficients ranging from .70 to 1.00 when utilised with a sample from the general population (Sobell, Sobell, Leo, & Cancilla, 1988). There are other methods of collecting such data e.g. asking individuals to recollect how often and how much alcohol they consume known as 'Quantity-Frequency' methods. These methods have been found to be less accurate than retrospective diary methods such as the TLFB (Sobell & Sobell, 1995). A copy of this measure can be found in Appendix 9.

2.4.3 Alcohol Urge Questionnaire (AUQ; Bohn, Krahn, & Staehler, 1995).

The AUQ is a well validated brief self-report questionnaire measuring current alcohol urge on a Likert-type rating scale ranging from 1 (strongly disagree) to 7 (strongly agree), with items 2 and 7 reverse scored. The questionnaire includes 8 items relating to 3 factors: desire for drink (4 items), expectation of the positive effects of drinking (2 items) and an inability to avoid drinking if alcohol was attainable (2 items). The total score is computed by averaging the item scores. Higher scores reflect greater craving. The AUQ was completed at two time points – before the administration of each of the measures of AB. A copy can be found in Appendix 10.

The AUQ has good internal consistency with a Cronbach's alpha level of between .91 to .93 test-retest reliability, construct and content validity (Bohn et al., 1995). Bohn and colleagues (1995) found that amongst a group of 40 alcoholics the AUQ scores showed high correlation (r = .82) when the retest interval was 1 day, and remained high (r = .78) following a 1 week retest interval. Among the 31 alcoholics in the subgroup who had been abstinent longer than 3 weeks, the 1 day test-retest correlation for the AUQ was significantly ($p < .05$) higher (0.84, $p <$

0.001) than the corresponding 1 week test-retest correlation (0.69, p <.001; Bohn et al.,1995). Higher AUQ scores were significantly related to higher alcohol dependence severity, greater alcohol-related cognitive preoccupation, and shorter duration of abstinence (Bohn et al., 1995).

2.4.4 The Alcohol Use Disorders Identification Test (AUDIT; Babor et al., 2001).

The AUDIT is a ten-item self-report questionnaire developed to measure if a person's alcohol use is hazardous, harmful or if there is possible alcohol dependence. The ten items are split into three domains; questions 1-3 deal with hazardous alcohol use, 4-6 relate to alcohol dependence and 7-10 consider alcohol related problems. Each item is scored between 0 and 4 with cut off scores of 7, 15, and 19 indicating lower risk, increasing risk and higher risk of hazardous or harmful alcohol consumption respectively. A score of 20 or more is suggestive of alcohol dependence. A copy can be found in Appendix 11. The AUDIT was cross nationally standardised and was validated on primary health care patients from six countries (Saunders, Aasland, Babor, de la Fuente, & Grant, 1993). High internal consistency (α = .93; Saunders et al., 1993) was reported. The AUDIT has been demonstrated to provide an accurate measure of risk across gender, age and cultures (Allen, Litten, Fertig, & Babor, 1997; Saunders et al, 1993); and has demonstrated good psycho-metric properties across a variety of populations, including university students (Kokotailo et al., 2004) with Cronbach's alpha level of .80 (Fleming, Barry, & MacDonald, 1991).

2.4.5 The Patient Health Questionnaire-9 (PHQ-9; Kroenke, Spitzer, Williams, & Löwe, 2010).

The PHQ-9 is a nine-item self-report measure of depression, which is widely used, including as an initial screening in Improving Access to Psychological Therapies ([IAPT]; National Health Service, 2010) adult mental health services in the UK. Each item is scored between 0 and 3 with cut off scores of 0-5, 6-10, 11-15, and 16-20 for mild, moderate, moderately severe and severe depression respectively. A copy can be found in Appendix 12. The PHQ-9 has demonstrated good criterion validity (Kroenke et al., 2010) and internal consistency, with a Cronbach's alpha between .86 and .89 (Kroenke, Spitzer, & Williams, 2001). Test-retest reliability was also demonstrated to be good when the retest time was 48 hours later, with Cronbach's alpha = .84 (Kroenke, Spitzer, & Williams, 2001).

2.4.6 The Generalised Anxiety Scale-7 (GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006).

The GAD-7 is a widely used seven item self-report measure of generalised anxiety. As with the PHQ-9, it is used as an initial screening tool in IAPT (National Health Service, 2010) adult mental health services in the UK. Each item is scored between 0 and 3 with cut off scores of 0-5, 6-10, 11-15, and 16-20 for mild, moderate, moderately severe and severe anxiety respectively. A copy can be found in Appendix 13. The GAD-7 has been shown to have good criterion validity (Spitzer et al., 2006; Kroenke et al., 2010) and internal consistency within the general population (α = .89; Löwe et al., 2008).

2.4.7 The visual probe task.

The visual probe task is a well validated and widely used computer based measure of AB (Schoenmakers et al., 2008). The visual probe task was administered alongside a FET (v1.01; Applied Science Laboratories, Bedford, MA, USA; Figure 1.2). Ten pairs of matched neutral pictures (depicting stationary items) and alcohol-related pictures made up the stimulus set. Each image was 100mm high by 125mm wide and were matched on perceptual features including brightness and complexity (Figure 1.2). Every trial began with a fixation cross (+) being shown in the middle of the computer screen for 1000ms. Images were counterbalanced on the right and left hand side of the computer screen 60mm away from each other. The images appeared on the screen and would then go off the screen after 2000ms. A white arrow pointing either up or down (known as the probe) was then shown in either the right- or left-hand part of the computer screen until a response was given by the participant or upon reaching 6000ms. Each trial was separated by 500ms and probes replaced alcohol-related stimuli on 50% of the total trials. Ten practice trials where completed with neutral picture pairs followed by two buffer pairs which were presented at the start of the experimental trial. After this 80 alcohol–neutral pairs of pictures were shown. Participants were requested to look at the fixation cross in the centre of the computer screen and to press a key marked with an arrow pointing down or up to indicate the direction of the probe as quickly as possible (Figure 1.3). The fixation duration (the total time spent looking at alcohol-related and neutral stimuli, also known as 'dwell time') for alcohol-related and neutral stimuli was computed. AB was measured by subtracting the total fixation duration for alcohol-related stimuli from the total fixation duration for neutral stimuli.

2.4.8 The bar laboratory.

The bar laboratory was set up in a naturalistic manner (Figures 1.4 & 1.5), with several stimuli in the form of areas of interest (AOI) (Figure 1.5). In total the bar laboratory had 13 AOI (eight areas containing alcohol-related stimuli, one area containing a type of alcohol free beverage, [in the form of bottles of alcohol free beer], and four areas containing soft drinks [non-alcohol]; (Figure 1.5). There were twice as many alcohol AOI as non-alcohol AOI to represent the usual ratio of alcohol to non-alcohol drinks generally seen in bars.

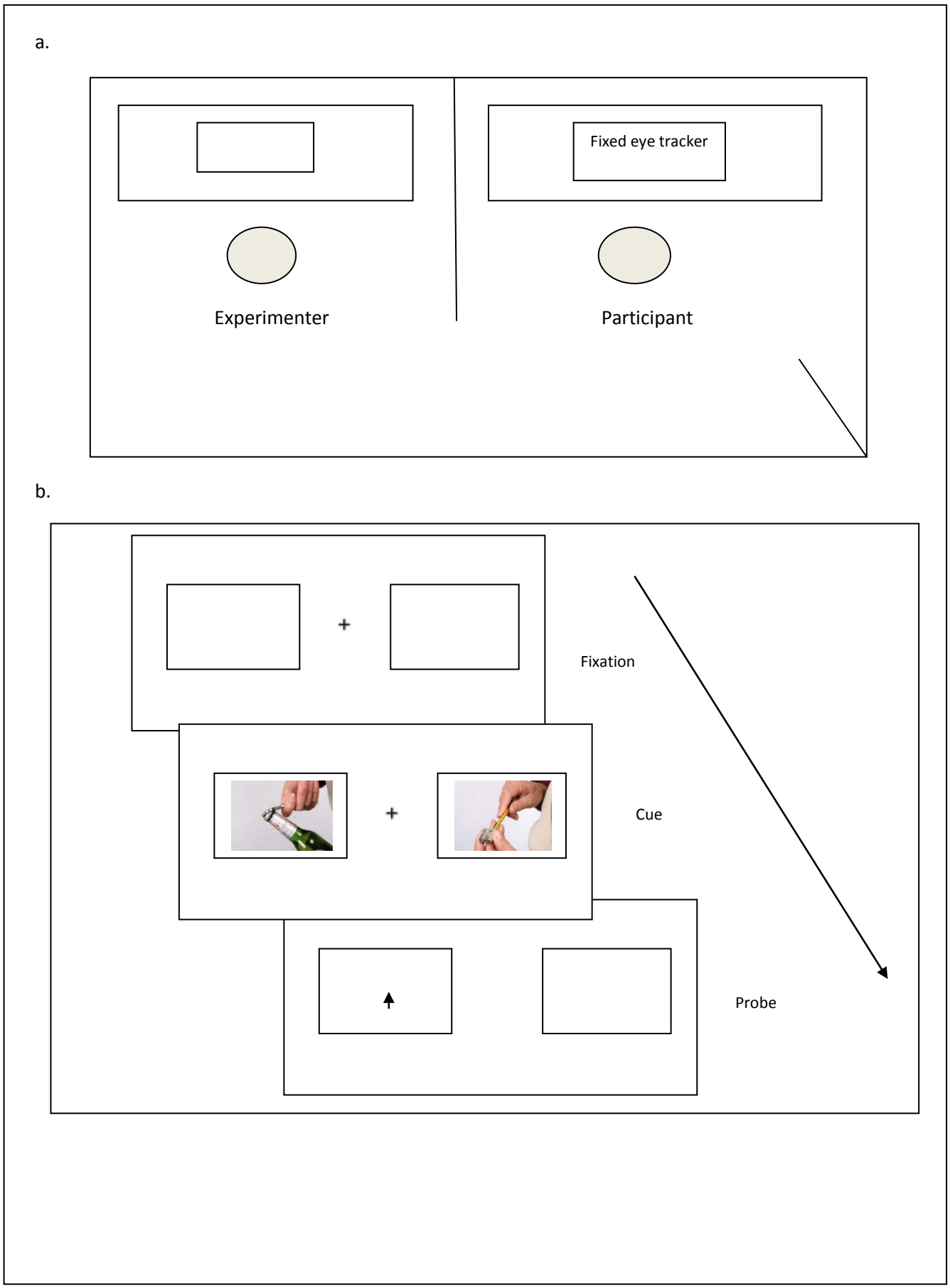

Figure 1.3. Schematic drawing of a bird's eye view of the eye laboratory (a) and diagram of an example of the visual probe stimuli (b).

a.

b.

Figure 1.4. The bar laboratory stimuli (a) and head mounted eye tracker infrared marker locations (b).

a.

b.

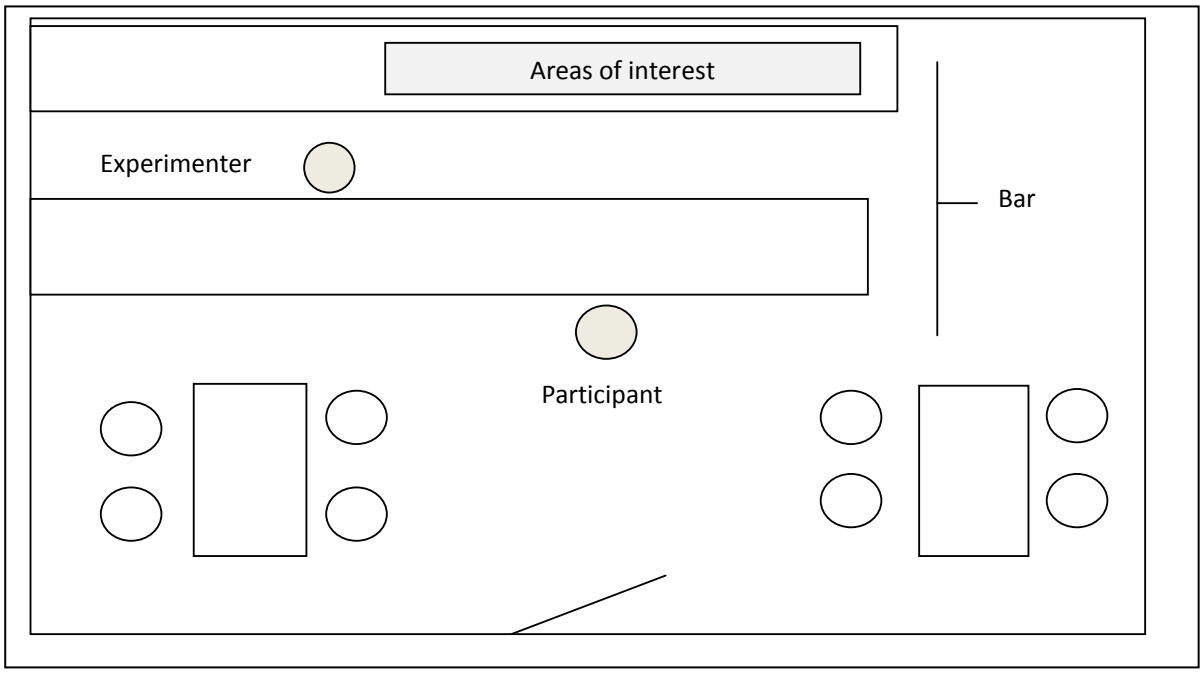

Figure 1.5. The bar laboratory areas of interest (AOI) (a) and a schematic drawing of a bird's eye view of the bar laboratory set-up (b).

2.4.9 The head mounted eye tracker (HMET; Tobii Glasses Eye Tracker, Tobii Technology, Danderyd, Sweden).

On entering the bar laboratory participants were instructed to put on the HMET glasses, which are similar to wearing a regular pair of glasses (Figure 1.6). Following calibration, participants were asked to sit at a barstool in front of the bar displaying the AOI (Figure 1.5). The HMET glasses have been widely used for marketing and consumer research, however the researcher has not found any evidence to date of its use within addiction research, and there are no published details in relation to its psychometric properties. Twenty one infrared (IR) markers were placed on the three shelves of the bar (Figure 1.4); seven on each shelf enabling the monitoring of the participants' eye movements. A recording assistant device recorded the eye tracking data and assisted in the calibration ensuring reliability. The HMET glasses recorded throughout the duration of the participants' time in the bar laboratory, with only five minutes duration extracted as the experimental data. These five minutes represented the period of time the researcher left the participant alone in order to enable the measurement of naturalistic eye movements in response to the bar laboratory stimuli.

Figure 1.6. Image of the head mounted eye tracker.

2.4.10 Localisation and scenario task.

These two tasks were developed for this study and were used as a rationale for the participants presence in the bar laboratory. The localisation task consisted of three alcohol questions and three soft drink questions asking the participant to locate where certain drinks were on the bar. For example, 'Can you please tell me where the Carlsberg is?' as an alcohol related question, or a neutral question 'Can you please tell me where the lemonade is?'. The scenario task involved participants being presented with two scenarios: a) an adult dinner party, b) a charity event. They were told they had a £100 budget for each scenario and a list of drink prices was provided. Participants were asked to spend the whole £100 in each scenario with the researcher keeping track of the total amount spent. A copy of these tasks can be found in Appendix 14.

2.5 Testing Procedure

A verbal explanation of what participation in the study would involve was given prior to signing the consent form and to enable participants to ask questions or report any problems (i.e. problems with literacy). Written informed consent was then obtained. Each participant provided a breath alcohol reading (which must read 0.0 mg/l). The screening questionnaire and demographic data was collected to ensure the individual's eligibility. Participants were allocated to one of two groups to allow the measures to be counterbalanced (see Figure 1.7).

Participants completed the two measures of AB, FET with the visual probe task in the eye-laboratory, and the HMET with the localisation and scenario tasks in

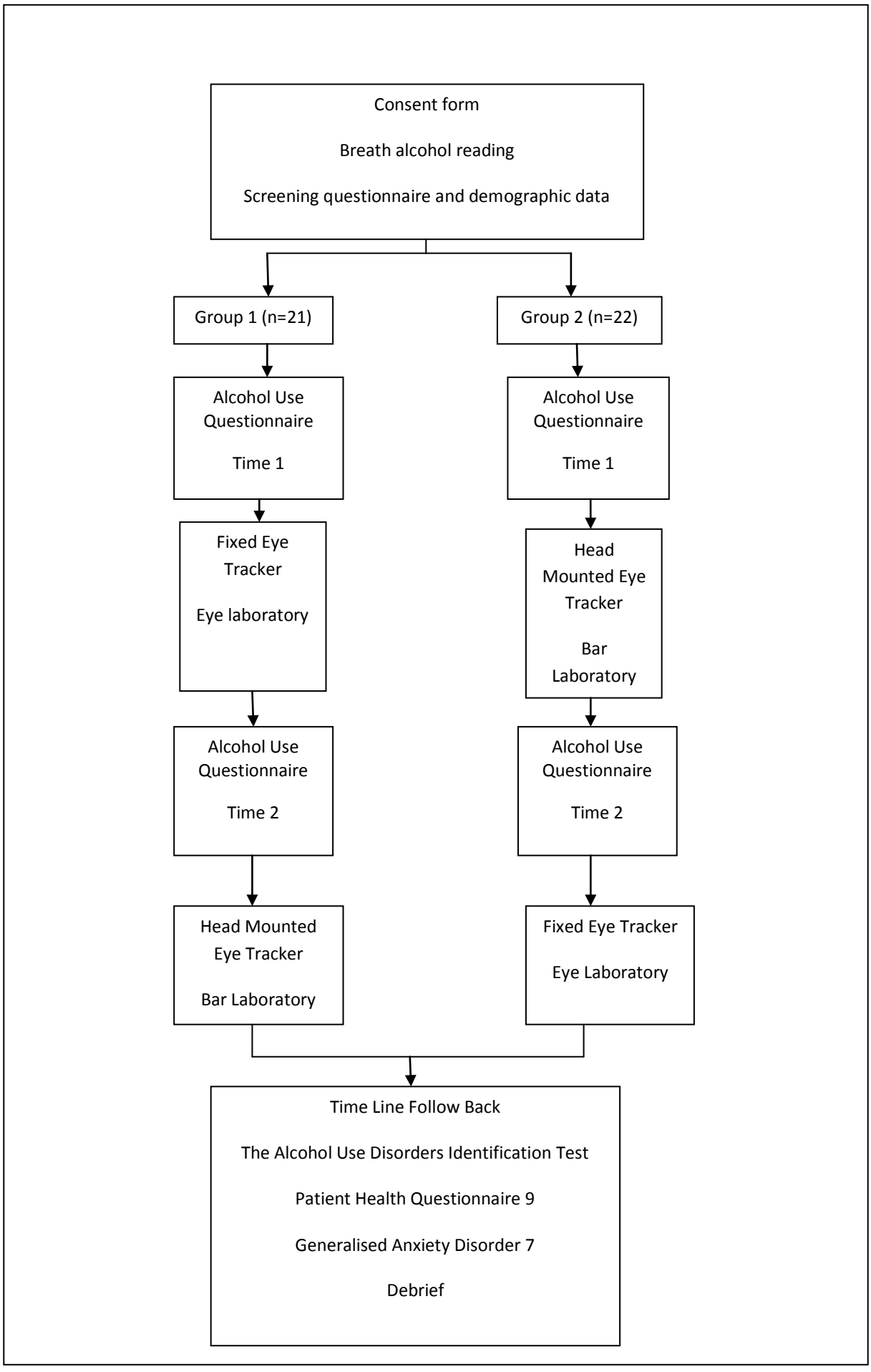

Figure 1.7. Flow of the ordering of the counterbalanced measures .

the bar laboratory. Once the HMET was calibrated participants were sat down, on a bar stool, in front of the bar and were instructed to remain seated throughout their participation. The researcher then made an excuse and left the participants for five minutes to enable their natural AB, in relation to the AOI, to be measured. When the researcher returned, participants completed the localisation and scenario tasks as a rationale for being in the bar laboratory. Prior to the completion of each measure of AB participants completed the AUQ (Bohn et al., 1995). After completion of both measures of AB participants completed the TLFB (Sobell et al., 1979), GAD-7 (Spitzer et al., 2006) and PHQ-9 (Kroenke et al., 2010). The measures of mood (GAD-7 and PHQ-9) were completed at the end of the session so not to prime for mood. Completed measures were checked for omissions. If any omissions were found participants were asked if they had omitted completing these items due to error or choice. If they had omitted an item due to choice the items were left blank, otherwise the participants were asked to complete the missing items. Data collection took on average 50 minutes and participants were debriefed and provided with a debrief sheet containing relevant telephone contacts and website addresses. A copy can be found in Appendix 15. Participants were reminded they had a point of contact if they wanted any further information or if they decided to withdraw from the study at a later date. Participants who were undergraduate psychology course students received 5 EPR points for participation. If they had already collected all their EPR points or if they were not an undergraduate psychology student participants received £5 cash as compensation for their time in taking part in the study. Finally, participants were asked if they would like to receive a summary of results to be e-mailed to a preferred e-mail address once the study had been completed.

2.6 Analysis and Data Reduction

Questionnaire measures were manually scored according to the author's instructions. The FET data was extracted and initial analysis for the HMET was completed using the software, before all the relevant data was exported. All of the data, including demographic data was inputted into SPSS (IBM Corp, Statistical Package for Social Sciences, Version 21, 2012) for analysis.

Data reduction was implemented for data collected on the FET data. On each trial, gaze position was recorded at a sampling rate of 120Hz during the 2,000ms in which alcohol-neutral pairs were presented. If eye movements were stable within one degree of visual angle for 100ms or longer, this was classed as a fixation to that position. Fixation duration on alcohol and neutral pictures was computed using ASL 'Results' software (v1.01; Applied Science Laboratories, Bedford, MA) by summing the total amount of time that fixations were directed at the regions of the screen occupied by the pictures. This method is commonly used to assess the duration of eye movement fixations to specific areas of interest in visual probe tasks. The fixation duration measure has good concurrent validity with reaction time measures of AB (e.g. Field et al., 2004; Mogg et al., 2003). A total fixation duration variable (total fixation alcohol plus total fixation neutral) was then computed. Four participants' total fixation time was less than 200ms, indicating that their eye gaze was directed outside the neutral and alcohol stimuli for the majority of the time. Therefore the data from these participants was discarded. Due to technical problems there was incomplete eye movement data from four participants, so data on the FET for these participants was also discarded (N = 35).

The HMET recorded throughout the duration of the participants time in the bar laboratory, however only a five minute duration was extracted as the experimental data. These five minutes represented the period of time the researcher left the participant alone in order to enable the measurement of naturalistic eye movements in relation to the bar laboratory stimuli. Outcome variables collected were: total fixation duration (the sum of the duration of all fixations within an AOI, therefore how long a participant fixated on an area of interest, a direct comparison measure to the FET fixation duration outcome variable), time to first fixation (how long it takes a participant to fixate on an AOI ,which represents how quickly eye gaze was directed to a specific area of interest) and visit count (the number of visits within an AOI, the number of times eye gaze was directed to a specific area of interest). It is worth noting that the mean scores for total fixation duration and total visit count were divided by two for the alcohol group to account for the fact there were twice as many alcohol as non-alcohol AOI. There was a technical failure that prevented one participant's data being extracted from the HMET recording device (n= 42).

Three further variables were also computed. First, an alcohol composite score was computed. This was computed by combining data from the TLFB (total binge days over two weeks and total days drinking over two weeks) and the total AUDIT score by computing the *z*-score for each variable. The alcohol composite score equalled the mean of the total of all the *z*-scores. Second, two AB variables were also computed. First, was an AB variable was created with the FET data. This was computed by subtracting the total alcohol fixation duration time from the total neutral fixation duration time. Second, an AB variable was also created with data

from the HMET data. This was computed by subtracting the total alcohol fixation duration time from the total non-alcohol fixation duration time.

Finally, it was decided that the data collected on the HMET for the alcohol free AOI would not be utilised in the analysis. It was felt that as there was only one non-alcohol AOI, comparison between alcohol and non-alcohol AOI would not provide meaningful results. This is a recognised limitation.

A number of statistical tests were used to analyse the data. Descriptive statistics were produced to decide if parametric or non-parametric analyses would be conducted. A correlational design was initially used to explore the relationship between the two measures of AB. Statistical analysis is discussed in detail in the next chapter.

2.7 Data Screening

Frequencies were calculated in order to identify any incorrectly entered items and missing data. Missing data was identified for TLFB; TLFB average number of units consumed per hour (n = 1), TLFB number of occasions drunk over the past 6 months (n = 3), TLFB age of first alcoholic drink (n = 2), TLFB frequency of occasions drunk when drinking (n = 4) and TLFB age regularly began drinking (n = 8). This was due to participants failing to complete these items.

Data was then examined to identify outliers and non-normal distributions. An examination of box plots revealed the presence of outliers, closer inspection revealed these to be valid responses and within the range of possible scores, and as such they

were retained for use in the statistical analysis. No outliers where excluded within this data set as they were all valid responses.

Non-normality was initially indicated by visual scanning of histograms and significant skewness or kurtosis, according to z criterion ($z > 2.58$; Field, 2005) and confirmed by significance on the Kolmogorov-Smirnov and Shapiro-Wilk tests (Field, 2005; see Appendix 16). The primary variables from the FET of alcohol fixation duration and neutral fixation duration and the HMET variables of total fixation duration alcohol, visit count alcohol, visit count non-alcohol as well as scores on the AUDIT were normally distributed. However, several variables were not normally distributed including; alcohol composite score, FET AB variable, HMET AB variable, HMET total fixation duration non-alcohol and HMET first fixation non-alcohol, as well as scores on GAD-7, PHQ-9 and AUQ Time 1 and AUQ Time 2. Several factors of the TLFB were also non-normally distributed; number of drinking days (2 weeks), number of units drunk (2 weeks), average number of units drunk per drinking day (2 weeks), number of binges (2 weeks), total days abstinent (2 weeks), number of units consumed per hour (self-reported), number of occasions drunk over six months, frequency of times drunk when drinking and age regularly began to drink alcohol.

The majority of the non-normally distributed data were positively skewed. Therefore, logarithm and square root transformations were applied to the non-normally distributed variables in an attempt to correct for the distribution (see Appendix 16). Repeated visual scanning of logarithm and square root transformed data histograms and significant skewness or kurtosis was reviewed according to z criterion ($z > 2.58$; Field, 2005) and confirmed by significance on both the Kolmogorov-Smirnov and Shapiro-Wilk tests (Field, 2005). After reviewing the

transformed data it was felt that due to the homogenous nature of the kurtosis and skewness across the variables no single transformation procedure was corrective for the whole data set. Therefore, non-parametric analyses were performed when appropriate in addition to parametric tests.

Chapter 3: Results

This chapter details the results of the study. It comprises of seven sections. First, the reliability of the measures used are outlined. The second section examines group characteristics, including drinking characteristics. In the third section Wilcoxon Signed Rank Tests are discussed. The fourth to seventh sections comprise of correlational analyses. Section four explores associations between measures of AB derived from the FET and the HMET, the fifth section looks at the relationships between these AB measures and drinking related variables. The sixth section explores correlations between additional data collected from the FET and HMET, and drinking related variables. The final section explores further associations between mood related variables and the other outcome variables.

3.1 Reliability of Measures

When utilising psychometric measures it is important to ensure the reliability of chosen measures and good internal consistency is considered to be of paramount importance (Pallant, 2013). In this study, the internal consistency was calculated for the following scales; AUQ, AUDIT, PHQ-9 and GAD-7. The AUQ demonstrated good internal consistency, with a Cronbach's alpha level of .86 for Time 1 administration and .91 for Time 2 administration. The AUDIT and the PHQ-9 also demonstrated good internal consistency with a Cronbach's alpha of .82 for both measures. The Cronbach's alpha coefficient for the GAD-7 was .60, which falls slightly below the acceptable level of .07, however further analysis revealed that it had an acceptable inter-item correlation of .26 as described by Briggs and Cheek (1986).

3.2 Group Characteristics

Table 1 presents the demographic data for participants including age, anxiety as measured by the GAD-7, depression as measured by the PHQ-9, AUDIT and AUQ scores Time 1 and Time 2. As shown in Table 1 the mean age of participants was 20.37 years (*SD* = 2.33). The mean scores on the PHQ-9 and GAD-7 both fell within the mild range of depression and anxiety respectively. In addition, the mean scores on the AUQ increased from Time 1 (*M* = 1.73, *SD* = 0.83) to Time 2 (*M* = 1.98, *SD* = 1.10).

Table 1

Demographic Characteristics: Continuous Variables

Variable	*n*	*M(SD)*
Age	43	20.37 (2.33)
GAD-7 Anxiety	43	5.03 (3.73)
PHQ-9 Depression	43	5.65 (4.07)
AUDIT	43	10.23 6.20
AUQ		
Time 1	43	1.73 (0.83)
Time 2	43	1.98 (1.10)

Table 2.1

Demographic Characteristics: Categorical Variables

Variable	*n*	*%*
Gender		
Male	7	16.3
Female	36	83.7
Ethnicity		
White British	33	76.7
Black British	1	2.3
Mediterranean British	1	2.3
Pakistani British	1	2.3
Chinese British	1	2.3
White Irish	1	2.3
Black African	1	2.3
Chinese	3	7.0
Mixed Ethnicity	1	2.3
Student status		
Student	40	93.0
Non-student	3	7.0
Employment status		
Student	30	69.8
Unemployed	1	2.3
Employed	12	27.9
Type of employment		
Scientist	1	2.3
Researcher	1	2.3
Education	1	2.3
Retail	4	9.3
Waitress/Waiter	2	4.7
Bar work	3	7.0
Education		
Undergraduate degree level	36	83.7
Masters degree	4	9.3
PhD	3	7.0

Note. Ethnicity terms were those stated by participants.

Table 2.1 illustrates the demographic data for participants including gender, ethnicity, student status, employment status, type of employment and education. As can be seen in Table 2.1 83.7% (*n* = 36) of participants were female, with 76.7% of the sample describing themselves as White British. Ninety three percent (*n* = 40) of participants described themselves as students with 83.7% (*n* = 36) either currently undertaking or having previously completed an undergraduate level degree.

The demographic data for physical health problem, type of health problem, medication, type of medication, GAD-7 anxiety category, PHQ-9 depression category and AUDIT category can be seen in Table 2.2. Seven percent (*n* = 3) of participants reported having a physical health problem and 11.6% (*n* = 5) and 14% (*n* = 6) of participants reported having severely moderate levels of anxiety and depression respectively. Seven percent (*n* =3) of participants reported having possible dependence on alcohol as measured by the AUDIT.

3.2.1 Drinking characteristics.

The drinking characteristics of participants can be seen in Table 3. The mean age of first alcoholic drink was 14.8 (*SD* = 2.12), with the mean age of first beginning to regularly drink being 17.1 (*SD* = 2.16). Table 3 also illustrates the mean number of drinking days over two weeks was 3.62 (*SD* = 2.55) with a mean number of binge drinking days of 2.20 (*SD* = 2.24).

3.2.2 Tobacco use.

The majority of the group reported to be non-smokers (93%), with only three participants reporting they smoked (7%). Of those who did smoke, participants smoked a mean of 4.33 cigarettes per day.

Table 2.2

Demographic Characteristics: Categorical Variables

Variable	n	%
Physical health problem		
Yes	3	7.0
No	40	93.0
Type of health problem		
Asthma	1	33.3
Eczema	1	33.3
Migraine	1	33.3
Medication		
Yes	3	7.0
No	40	93.0
Type of medication		
Anti-histamine	1	33.3
Asthma inhaler	1	33.3
Beta-blockers	1	33.3
GAD-7 Anxiety		
Mild	27	62.8
Moderate	11	25.6
Moderately severe	5	11.6
PHQ -9 Depression		
Mild	26	60.5
Moderate	11	25.6
Moderately severe	6	14.0
AUDIT category		
Lower risk	13	30.2
Increasing risk	20	46.5
Higher risk	7	16.3
Possible dependence	3	7.0

Table 3

Drinking Characteristics

Variable	*n*	*M(SD)*	*Mdn*
TLFB No. drinking days (2 weeks)	43	3.62 (2.55)	4
TLFB No. units drunk (2 weeks)	43	27.61 (25.56)	24
TLFB Average units per drinking day (2 weeks)	43	5.94 (4.72)	6
TLFB Total binge days (2 weeks)	43	2.20 (2.24)	2
TLFB Total abstinent days (2 weeks)	43	10.16 (2.95)	10
TLFB Units consumed per hour (self reported)	42	4.16 (3.82)	3
TLFB No. episodes drunk in past 6 months	40	17.1 (18.3)	10
TLFB Frequency of occasions drunk when drinking	39	50.95 (33.39)	65
TLFB Age of first drink	41	14.80 (2.12)	15
TLFB Age when regularly began drinking alcohol	36	17.1 (2.16)	17

3.3 Differences between Alcohol and Non-alcohol/Neutral Stimuli

Table 4

Median and Mean Times (milliseconds) for Alcohol and Non-alcohol/Neutral Stimuli on the Fixed Eye Tracker and Head Mounted Eye Tracker

		Alcohol		Non-alcohol/neutral			
Variable	*n*	*M(SD)*	*Mdn*	M(SD)	*Mdn*	*Z*	*(p)*
Fixation Duration (FET)	35	.41 (.21)	.37	.46 (.21)	.42	-2.06	.04*
Fixation Duration (HMET)	42	5.35+ (1.98)	5.68	7.32 (4.99)	6.44	-2.67	.01*
Visit Count (HMET)	42	7.44+ (2.73)	7.12	11.21 (4.64)	11.63	-5.08	.00***
Time to 1st Fixation (HMET)	42	28.46 (9.42)	27.01	63.43 (26.81)	61.11	-5.54	.00***

*** p <0.001 (2-tailed)

* p <0.05 (2-tailed)

+ equals half the total mean score as there were twice as many Alcohol AOI as Non-Alcohol AOI

Due to the non-normal distribution of the FET fixation duration, HMET visit count and HMET time to first fixation variables, non-parametric analyses were performed to explore differences between participants' responses in relation to alcohol and non-alcohol/neutral stimuli on the FET and HMET. A Wilcoxon Signed Rank Test was conducted, the results of which are presented in Table 4.

As can been seen in Table 4 participants spent significantly longer looking at non-alcohol/neutral stimuli compared to alcohol stimuli on the variables FET fixation duration and HMET fixation duration. Table 4 also illustrates that on the HMET participants visited non-alcohol AOI significantly more times than alcohol AOI. Participants were also significantly quicker to first fixate on an alcohol versus non-alcohol AOI as measured by HMET.

3.4 Relationships between the Fixed Eye Tracker and Head Mounted Eye Tracker Variables

Correlational analyses were conducted between the variables FET fixation duration alcohol and fixation duration neutral and the HMET variables fixation duration, visit count and time to first fixation for both alcohol and non-alcohol stimuli. Spearman's Rho correlations were performed. The correlation coefficients and *p* values are shown in Table 5.

As can be seen in Table 5, there were no significant correlations between the HMET and FET variables. However, some significant correlations were found between some of the HMET variables. Table 5 illustrates that medium positive correlations were found between the following HMET variables; fixation duration alcohol and visit count non-alcohol (r = .45, n = 34, p = .03), fixation duration non-alcohol and visit count alcohol (r = .39, n = 34, p = .01), fixation duration non-alcohol and fixation duration alcohol (r = .33, n = 34, p = .04), and time to first fixation non-alcohol and time to first fixation alcohol (r = .31, n = 34, p = .05). Large positive correlations were found between fixation duration alcohol and visit count alcohol (r =.71, n =34, p = .00), fixation duration non-alcohol and visit count non-

alcohol (r = .80, n = 34, p = .00) and visit count alcohol and visit count non-alcohol (r = .68, n = 34, p = .00).

Table 5

Correlations Between the Head Mounted Eye Tracker and Fixed Eye Tracker Variables

	Fixation Duration FET (Alcohol) *(p)*	Fixation Duration FET (Non-alcohol) *(p)*	Fixation Duration HEMT (Alcohol) *(p)*	Fixation Duration HMET (Non-alcohol) *(p)*	1st Fixation HMET (Alcohol) *(p)*	1st Fixation HMET (Non-alcohol) *(p)*	Visit Count HMET (Alcohol) *(p)*	Visit Count HMET (Non - alcohol) *(p)*
Fixation Duration FET (Alcohol)	-	.82** (.00)	.04 (.84)	-.10 (.56)	-.26 (.14)	-.22 (.21)	.19 (.27)	.05 (.78)
Fixation Duration FET (Non-alcohol)		-	.12 (.49)	-.07 (.68)	-.10 (.56)	-.24 (.18)	.22 (.21)	.13 (.45)
Fixation Duration HMET (Alcohol)			-	.33* (.04)	-.16 (.33)	-.12 (.47)	.71** (.00)	.45* (.03)
Fixation Duration HMET (Non-alcohol)				-	-.04 (.78)	-.19 (.22)	.39* (.01)	.80** (.00)
1st Fixation HMET (Alcohol)					-	.31* (.05)	-.14 (.37)	-.09 (.56)
1st Fixation HMET (Non-alcohol)						-	-.12 (.50)	-.23 (.14)
Visit Count HMET (Alcohol)							-	.68** (.00)

* p <0.05 (2-tailed)

** p <0.01 (2-tailed)

3.5 Attentional Bias

3.5.1 Relationship between measures of attentional bias.

Hypothesis 1:

There will be a correlation between the two measures of AB derived from the FET and HMET.

The relationship between the study outcome variable AB derived from the two measures of AB, the FET and the HMET, were examined to test the primary hypothesis. Spearman's Rho correlations were performed due to the non-normal nature of the data. The results indicate that there was no significant correlation found between these two variables (r = -.22, n = 34, p = .22).

3.5.2 Relationship between measures of attentional bias and drinking variables.

Hypothesis 2:

Participants who have higher levels of alcohol consumption will have increased AB to alcohol-related cues.

The relationship between the outcome variable AB (FET and HMET), and drinking related variables were examined to test the second hypothesis. Spearman's Rho correlations were performed due to the non-normal nature of the data. The correlation coefficients and p values are shown in Table 6 and Table 7.

Table 6

Correlations Between Drinking Related Variables and Attentional Bias (Fixed Eye Tracker and Head Mounted Eye Tracker)

	Alcohol composite score *(p)*	AUQ Time 1 *(p)*	AUQ Time 2 *(p)*	AUDIT *(p)*
FET AB	.35* (.04)	.41* (.02)	.43* (.01)	.46** (.01)
HMET AB	-.23 (.14)	.02 (.90)	-.15 (.35)	-.17 (.29)

* p <0.05 (2-tailed)

** p <0.01 (2-tailed)

As can be seen in Table 6 and Table 7, there were no statistically significant correlations found between the HMET AB variable and any of the drinking related variables i.e. alcohol composite score, AUQ time 1 and time 2, AUDIT and the TLFB. As can be seen in Table 6, medium positive correlations were found between the FET AB variable and the alcohol composite score, AUQ Time 1 and Time 2 and the AUDIT. Medium positive correlations were also found between the FET AB variable and the TLFB average units per drinking day (2 weeks), number of binges (2 weeks) and number of times drunk over 6 months as illustrated in Table 7. There was a large positive correlation between the FET AB variable and TLFB frequency of occasions drunk when drinking variable (see Table 7). There were no other statistically significant associations found.

Table 7

Correlations Between TLFB Variables and Attentional Bias (Fixed Eye Tracker and Head Mounted Eye Tracker)

	TLFB No. of drinking days (2 weeks) *(p)*	TLFB No. of units drunk (2 weeks) *(p)*	TLFB Average units drunk per drinking day (2 weeks) *(p)*	TLFB No. Binges (2 weeks) *(p)*	TLFB No. of Units drunk per hour (self reported) *(p)*	TLFB No of episodes drunk over 6 months *(p)*	TLFB Age regularly began drinking alcohol *(p)*	TLFB Frequency of occasions drunk when drinking *(p)*	TLFB Age first had a drink *(p)*	TLFB No. abstinent days (2 weeks) *(p)*
Attentional bias FET	.19 (.29)	.30 (.08)	.37* (.03)	.39* (.02)	.22 (.21)	.36* (.04)	-0.4 (.11)	.54** (.00)	-.31 (.11)	-.25 (.15)
Attentional bias HMET	-.18 (.26)	-.19 (.24)	-.07 (.68)	-.13 (.40)	-.13 (.42)	-.13 (.45)	.23 (.18)	-.03 (.84)	.05 (.75)	. .23 (.14)

* $p<0.05$ (2-tailed)

** $p<0.01$ (2-tailed)

3.6 Relationships between the Fixed Eye Tracker, Head Mounted Eye Tracker and Drinking Variables

The relationship between the outcome variables relating the HMET, the FET and drinking related variables were also examined. Spearman's Rho correlations were performed. The correlation coefficients and *p* values are shown in Table 8 and Table 9. As shown in Table 9 there was only one medium positive correlation found within these analyses between FET fixation duration neutral and TLFB age regularly began drinking ($r = .44$, $n = 28$, $p = .02$). No other positive or negative correlations were found between any of the other HMET or FET variables and the drinking related variables.

Table 8

Correlations Between the Head Mounted Eye Tracker, Fixed Eye Tracker and Drinking Variables

	Alcohol composite score *(p)*	AUQ Time 1 *(p)*	AUQ Time 2 *(p)*	AUDIT *(p)*
FET Fixation Duration Alcohol	.11 (.54)	.18 (.31)	.22 (.22)	.03 (.86)
FET Fixation Duration Neutral	-.11 (.52)	.01 (.98)	.06 (.93)	-.20 (.25)
HMET Total fixation duration Alcohol	.13 (.40)	.23 (.15)	.28 (.08)	.01 (.94)
HMET Total fixation duration Non-alcohol	.27 (.09)	.09 (.56)	.23 (.14)	.15 (.33)
HMET First fixation Alcohol	-.15 (.33)	-.16 (.32)	-.08 (.61)	-.02 (.91)
HMET First fixation Non-alcohol	-.13 (.42)	-.25 (.12)	-.13 (.40)	-.07 (.66)
HMET Visit Count Alcohol	.09 (.58)	.26 (.10)	.23 (.15)	.10 (.53)
HMET Visit Count Non-alcohol	.21 (.19)	.08 (.60)	.11 (.47)	.11 (.49)

Table 9

Correlations Between TLFB, Head Mounted Eye Tracker and Fixed Eye Tracker Variables

	TLFB No. of drinking days (2 weeks) (p)	TLFB No. of units drunk (2 weeks) (p)	TLFB Average units drunk per drinking day (2 weeks) (p)	TLFB No. Binges (2 weeks) (p)	TLFB No. of Units drunk per hour (self reported) (p)	TLFB No of episodes drunk over 6 months (p)	TLFB Age regularly began drinking alcohol (p)	TLFB Frequency of occasions drunk when drinking (p)	TLFB Age first had a drink (p)	TLFB No. abstinent days (2 weeks) (p)
FET										
Fixation Duration	.13	.11	.10	.26	.01	.08	.33	.08	-.01	-.15
Alcohol	(.46)	(.52)	(.58)	(.14)	(.94)	(.67)	(.09)	(.66)	(.97)	(.38)
FET										
Fixation Duration	-.02	-.07	-.12	-.00	-.13	-.15	.44*	-.23	-.02	.03
Neutral	(.93)	(.69)	(.48)	(.99)	(.47)	(.40)	(.02)	(.21)	(.92)	(.87)
HMET										
Total fixation										
duration	.26	.23	.13	.14	.04	.01	.19	.01	.01	-.20
Alcohol	(.10)	(.14)	(.41)	(.37)	(.81)	(.94)	(.29)	(.97)	(.96)	(.21)
HMET Total										
fixation duration	.24	.26	.11	.16	.21	.06	-.20	-0.3	-.00	-.30
Non-alcohol	(.13)	(.10)	(.51)	(.31)	(.18)	(.71)	(.25)	(.87)	(.99)	(.06)
HMET First										
fixation	-.19	-.11	-.12	-.10	.02	-.15	.11	-.00	-.02	.26
Alcohol	(.21)	(.47)	(.46)	(.52)	(.89)	(.37)	(.55)	(.98)	(.89)	(.09)
HMET First										
fixation	-.15	-.18	-.21	-.19	.02	-.15	.11	-.00	-.02	.19
Non-alcohol	(.34)	(.27)	(.19)	(.23)	(.89)	(.37)	(.55)	(.98)	(.89)	(.21)
HMET Visit Count	.19	.12	.01	.02	.08	.13	.04	.00	-.08	-.12
Alcohol	(.24)	(.46)	(.95)	(.91)	(.64)	(.42)	(.81)	(.98)	(.64)	(.44)
HMET Visit Count	.21	.18	.02	.10	.17	.10	-.13	-.07	-0.3	-.23
Non-alcohol	(.19)	(.26)	9.89)	(.55)	(.28)	(.55)	(.46)	(.66)	(.86)	(.15)

3.7 Relationships with Mood Related Variables

3.7.1 Relationships between mood and measures of attentional bias.

The relationships between mood related outcome variables and AB (as derived by the FET and HMET) were also examined. Spearman's Rho correlations were performed due to the non-normal nature of the data. The correlation coefficients and *p* values are shown in Table 10. As demonstrated in Table 10 there were no significant associations found between these variables.

Table 10

Correlations Between Measures of Attentional Bias (Fixed Eye Tracker and Head Mounted Eye Tracker) and Measures of Mood

	GAD-7 Anxiety *(p)*	PHQ-9 Depression *(p)*
Attentional Bias FET	.10 (.59)	.12 (.49)
Attentional Bias HMET	.06 (.70)	.20 (.20)

3.7.2 Relationships between mood and drinking.

The relationships between mood related outcome variables and drinking related variables were also explored. Spearman's Rho correlations were performed due to the non-normal nature of the data. The correlation coefficients and *p* values

are shown in Table 11. As demonstrated in Table 11 there were no significant associations found between these variables.

Table 11

Correlations Between Measures of Mood and Drinking Variables

	GAD-7 Anxiety *(p)*	PHQ-9 Depression *(p)*
Alcohol composite score	-.07 (.65)	-.12 (.43)
AUQ Time 1	.14 (.38)	.08 (.59)
AUQ Time 2	-.03 (.87)	-.07 (.66)
AUDIT	.09 (.58)	.01 (.93)
TLFB No. of drinking days (2 weeks)	-.08 (.62)	-.17 (.27)
TLFB No. of units drunk (2 weeks)	-.07 (.32)	-.16 (.32)
TLFB Average units drunk per drinking day (2 weeks)	-.08 (.63)	-.18 (.25)
TLFB No. Binges (2 weeks)	-.15 (.35)	-.08 (.60)
TLFB No. Units drunk per hour (self-reported)	-.12 (.46)	-.19 (.22)
TLFB No of episodes drunk over 6 months	.06 (.70)	-.06 (.72)
TLFB Age regularly began drinking alcohol	-.11 (.51)	-.09 (.60)
TLFB Frequency of occasions drunk when drinking	-.09 (.55)	-.11 (.52)
TLFB Age first had a drink	.24 (.14)	.21 (.19)
TLFB No. of abstinent days (2 weeks)	.05 (.76)	.14 (.38)

3.7.3 Relationships between mood, fixed eye tracker and head mounted eye tracker variables.

Finally, the relationships between mood related, FET and HMET variables were explored. Spearman's Rho correlations were again performed due to the non-normal nature of the data. The correlation coefficients and *p* values are shown in Table 12.

As can be seen in Table 12, significant medium sized negative correlations were found between scores on the GAD-7 Anxiety and the FET fixation duration alcohol (r = -.44, n = 35, p = .00) and FET fixation duration neutral variables (r = -.43, n = 35, p = .01) suggesting that lower levels of anxiety were associated with increased fixation duration for both neutral and alcohol stimuli. Table 12 also illustrates that medium negative correlations were also found between the PHQ-9 Depression scores and HMET total fixation duration alcohol (r = -.32, n = 42, p = .04) and non-alcohol (r = -.37, n = 42, p = .02) indicating lower levels of depression were associated with increased fixation duration on alcohol AOI and non-alcohol related AOI on the HMET. A medium negative correlation was also found between HMET visit count non-alcohol and scores on the PHQ-9 Depression (r = -.35, n = 42, p = .02) as shown in Table 12, indicating lower scores on the PHQ-9 Depression was associated with more visits to non-alcohol related AOI.

Table 12

Correlations Between Head Mounted Eye Tracker, Fixed Eye Tracker and Mood Variables

	GAD-7 Anxiety *(p)*	PHQ-9 Depression *(p)*
FET Fixation Duration Alcohol	-.44** (.00)	-.26 (.13)
FET Fixation Duration Neutral	-.43* (.01)	-.27 (.12)
HMET Total fixation duration Alcohol	-.24 (.13)	-.32* (.04)
HMET Total fixation duration Non-alcohol	-.18 (.25)	-.37* (.02)
HMET First fixation Alcohol	-.04 (.78)	-.14 (.37)
HMET First fixation Non-alcohol	-.19 (.22)	-.11 (.50)
HMET Visit Count Alcohol	-.25 (.12)	-.27 (.09)
HMET Visit Count Non-alcohol	-.12 (.16)	-.35* (.02)

* $p < 0.05$ (2-tailed)

** $p < 0.01$ (2-tailed)

Chapter 4: Discussion

This chapter discusses the results in relation to the aims and hypotheses of the study. The first section discusses each hypothesis and relates the findings back to the existing literature. The methodological limitations of the study are then discussed. The theoretical and clinical implications and ideas for future research are also presented.

4.1 Summary of Findings

The aim of this study was to investigate if traditionally used laboratory-based measures of AB corresponded with how people attend to alcohol stimuli in real-world settings. This study specifically sought to address if there was any correlation between a laboratory-based measure of AB utilising a fixed eye tracker (FET) and a naturalistic method of measuring AB through head mounted eye-tracking (HMET) equipment. The results found no significant correlations between these two measures of AB. There were some significant correlations found, however, between drinking-related variables, craving and the FET AB variable, supporting previous findings within the literature. No significant relationships were found between the drinking-related variables, craving and the HMET AB variable. Additional analyses found no relationship between mood and AB, as measured by both measures, and drinking-related variables. However, there were some significant correlations found between the FET fixation duration variables, the HMET fixation duration, first fixation and visit count variables and the mood-related variables. These findings will now be discussed in detail.

4.1.1 Measures of attentional bias.

Hypothesis 1 predicted that there would be a correlation between the two measures of AB.

The results of this study found no correlation between the traditional laboratory-based measure of AB (FET) and the HMET measure of AB. This result provides an interesting contribution to the current literature and debate on measures of AB.

There has been much debate as to the most useful and efficacious measurement of AB in relation to clinical and research fields. AB can be measured directly (eye movements) or inferred with responses such as reaction times. The efficacy and ecological validity of laboratory-based methods have been criticised (Ataya et al., 2012b) and there has been recent debate regarding the internal reliability (Ataya et al., 2012a, 2012b; Field & Christiansen, 2012) of the two most widely used laboratory-based measures of AB, the visual probe and the Stroop task. Field and Christiansen (2012) and Ataya and colleagues (2012a) suggest the poor internal reliability of these measures may be due to the use of more common measures such as reaction time to infer AB. They suggest this method may be 'inherently noisy' (Ataya et al., 2012a) due to the multiple cognitive and motor processes involved. The role of AB in alcohol addiction, is established within the current literature, and some of the findings of this study support this and will be discussed, however, the challenge remains how best to measure this phenomenon. Eye movement measures have been suggested to have superior internal reliability (Ataya et al., 2012a; Field & Christiansen, 2012) and ecological validity.

This study found no relationship between the FET and the HMET measures of AB. This finding may be explained by the differences in duration of presentation of alcohol-related stimuli within these two measures. During administration of the HMET measure participants entered the bar-laboratory and completed an equipment calibration process before completing the experimental section. Participants who completed the HMET measure first completed the screening questions, breathalyser test, and questionnaires (drinking related and craving) prior to the calibration process whilst sat in the bar-laboratory. Therefore, participants spent a significant amount of time exposed to alcohol-related stimuli, before the experimental conditions began.

Referring to the evidence provided by studies using the visual probe task investigators have suggested that by manipulating the amount of time that substance-related stimuli are presented, one can investigate the biases in initial orientating versus disengagement of attention from those cues (Bradley et al., 2004). In the bar-laboratory utilising the HMET, participants were exposed to alcohol-related stimuli for up to 15 minutes prior to the experimental conditions, which may have significantly influenced the processes under scrutiny. Being exposed to the stimuli for longer periods would allow for multiple shifts of attention between alcohol and non-alcohol related stimuli. AB has been shown to be captured when stimuli are presented for up to 2000ms, however it is not known if AB persists past this initial exposure or if other processes are being measured after this. The results also indicated that participants were quicker to first fixate on alcohol versus non-alcohol area of interest [AOI] that may indicate an initial orientation bias for alcohol-related stimuli during the experimental conditions.

The results showed that on the HMET participants overall spent longer looking at non-alcohol related stimuli compared to alcohol-related stimuli, they also

visited non-alcohol related AOI more often than alcohol-related AOI. Research looking at inpatient alcoholics suggested that AB observed after a longer duration of stimuli presentation are more likely to reflect attentional avoidance or disengagement of attention from the stimuli (Noel et al., 2006; Stormark et al., 1997; Townshend & Duka, 2007;Vollstadt-Klein et al., 2009). However, it is difficult to explain why this pattern of attentional avoidance was observed in the current study within a student population.

Although there have been no studies looking at the use of eye tracking measures of AB in naturalistic settings within the literature on alcohol addiction, one study has investigated the use of a mobile eye-tracker procedure to assess visual attention to smoking cues by smokers and non-smokers in a naturalized environment (Baschnagel, 2013). Within this study the number and duration of fixations made to smoking cues located in an office space environment by smokers, after a period of abstinence and non-abstinence, and non-smokers was analysed. The results found that smokers made significantly more fixations to the smoking cues than non-smokers when abstinent; however, the analysis of fixation duration indicated that smokers did not make longer fixations on the smoking cues compared to non smokers regardless of smoking condition, abstinent or non-abstinent. Fixation duration also did not differ within smokers across smoking condition. Analysis indicated that non-smokers and smokers did not significantly differ in the overall number of fixations to all objects during the experimental session. There were a number of methodological flaws with this study, with the sample made up of relatively light smokers; and, as in the current study, participants spent a period of time prior to the experimental condition exposed to the stimuli before the experimental condition began, which may have influenced results.

Recent research has also explored the impact of stimulus complexity in the measurement of AB. Research utilising the visual probe task has suggested that complex alcohol-related images may be less effective at capturing drinkers' attention and may, therefore, result in less AB (Miller & Fillmore, 2010). Miller and Fillmore (2010) examined the effect of image complexity by comparing AB to complex versus simple images. Complex images depicted real-life scenes involving alcohol, for example, bar and party scenes with people consuming alcohol, whereas simple images depicted a single solitary image of an alcoholic beverage. The results of this study suggested that drinkers displayed AB towards simple images as opposed to the complex images. The authors suggested that complex images depicting environmental settings introduced more non-alcohol related features that could compete for attention. In the current study participants were exposed to an environmental setting that had a wide range of complex, tactile and sensory stimuli. It is possible that the environmental stimuli was much greater than the alcohol-related stimuli and therefore overcame the incentive-salience of the alcohol-related stimuli.

The findings of this current study suggest that alternative measures and methodologies in relation to the processes of AB may require further exploration. Recent research has focused on the use of neurocognitive measures and it has been suggested that such measures may be better predictors than self-report measures (Marhe et al., 2013). Research findings have provided evidence to support the importance of AB in understanding the development and maintenance of alcohol addiction and have indicated the brain regions implicated in AB for alcohol-related cues include those involved in attentional processing (the anterior cingulate cortex and thalamus), areas of the cortico-striatal circuit related to motivational processes

(prefrontal area, ventral and dorsal striatum,) and regions involved in emotion processing (insula) (Crunelle et al., 2012; Gladwin et al., 2013; Vollstadt-Kelin et al., 2012). Despite the strong research evidence demonstrating the effectiveness of these neurocognitive measures in the field of AB research – due to the specialised and costly nature of the equipment it is not widely accessible within clinical and research fields. Debates regarding the practicability of these measures would also need to consider their internal reliability and ecological validity.

It is difficult to draw any strong conclusions as to the use of HMET as a measure of AB due to the methodological flaws of this study. However, its use in AB research is worthy of further investigation with different methodological approaches and this chapter will later suggest possible future research.

4.1.2. Alcohol consumption and attentional bias.

Hypothesis 2 predicted that participants who had elevated levels of alcohol consumption would have increased AB to alcohol-related cues.

There were some positive correlations found between the FET AB variable and some of the drinking-related variables, specifically the alcohol composite score, the AUDIT (a measure of alcohol use) and current drinking as measured by TLFB (i.e. average units drunk per drinking day, number of binges, number of episodes drunk in past six months and frequency of occasions drunk when drinking, age when first had alcoholic drink, age frequently began drinking) but not with historical drinking-related variables also measured by the TLFB (i.e. age regularly began drinking and age first had drink). These findings support previous research that has demonstrated that the magnitude of AB is proportional to the amount of alcohol people habitually consume (Cox et al., 2014). Field and Cox's (2008) review

summarises the evidence that suggests that amongst users of different substances, substance-related AB is directionally proportional to the quantity and frequency of the substance use.

However, this study found no relationships between the FET AB variable and some of the drinking-related variables measured by the TLFB, specifically the number of drinking days and number of units drunk over two weeks. These findings may be explained by a higher number of binge episodes reported compared to frequency of regular drinking. Participants reported fewer drinking days, however consumption on the days on which they drank was high, suggesting a pattern of binge drinking. There was also no evidence of correlations between the self-reported number of units drunk in an hour and the FET AB variable. This may be due to the self-report nature of the TLFB and issues relating to accurate recollection of drinking behaviour and social bias influences.

The results of this study found no relationship between any of the drinking-related variables and the more naturalistic measure of AB utilising the HMET measure. This is an important finding. Within this study AB, as measured in laboratory based settings (as measured by the FET), is associated with individual differences in drinking behaviour. However, the more 'naturalistic' measure of AB (as measured by the HMET) is not associated with individual differences in drinking behaviour nor is it associated with the laboratory-based measure of AB (FET). These findings suggest that AB as measured in the laboratory settings has no predictive validity for AB in the real world. However, there are several methodological limitations with the HMET that may also explain these findings. These limitations are discussed throughout this chapter.

These findings may be explained by the previous discussions relating to what cognitive and attentional processes the HMET measure may be capturing. The attentional system is not unitary, and different cognitive mechanisms may underlie the shifting and disengagement of attention (Allport, 1989; LaBerge, 1995). In addition, this finding provides contrary evidence in relation to predictions made in recent research as to the effects of AB modification training (ABM). Several studies (Christiansen et al., 2015; Mc Geary et al., 2014) have recently suggested that the measurement of AB and administration of ABM in more naturalistic settings (for example, environments in which substance use normally occurs [e.g. home or, as in the current study example, a bar]), may promote more robust measurements of AB and reductions in AB, craving and substance use. The findings of the current study would not support these hypotheses.

In relation to craving the findings demonstrated increases in level of craving from time 1 to time 2 administration of the AUQ (a measure of current alcohol craving) following exposure to alcohol-related stimuli. The findings also found a relationship between the FET AB variable and craving, however there was no relationship between the HMET and the AUQ. It is difficult to draw any firm conclusions regarding this due to the methodological flaws of the current study. Further exploration is required.

The finding of a relationship between measures of craving and the FET does, however, support previous studies which have also found substance-related AB to be associated with subjective craving for the substance (Field & Cox, 2008). In a recent review of craving and AB, Field and colleagues (2014) suggest that there is a small but robust association between craving and AB and that the magnitude of the

relationship increases when attention is measured directly (e.g. eye movements) rather than indirectly (e.g. reaction time measures from the Stroop task).

Processing biases in the orientation of attention to alcohol-related stimuli have been demonstrated in higher craving compared to lower craving social users of alcohol (Hobson et al., 2013). A meta-analysis looking at the relationship between AB and subjective craving (Field et al., 2009) found the association between craving and AB was larger when the strength of subjective craving was relatively high at the time of assessment. This indicated that AB is positively associated with craving and suggests high levels of craving are likely to be associated with greater AB to substance cues. This present study supports the theory that AB for substance-related cues is positively correlated with current levels of substance craving and provides further evidence in relation to Cox and Klinger's (1988, 2004), Franken's (2003), and Kavanagh and colleagues (2005) models that predict a reciprocal relationship between subjective craving and substance-related AB.

In addition, the overall results indicated that within this sample 69.8% of participants were shown to have an 'increasing risk' or greater likelihood of dependence upon alcohol based on the AUDIT. The average units per drinking day were reported to be 5.94 units, higher than the UK government guidelines (a maximum of 3-4 units per day for men and 2-3 units per day for women). As 83.7% of the sample was female this suggests average consumption of alcohol on a drinking day was nearly double the recommended daily allowance. However, the mean number of drinking days over two weeks was only 3.62 possibly indicating a pattern of binge drinking, with a self-reported average number of binge drinking days of 2.20 over two weeks, two thirds of the overall number of drinking days reported. However, the average number of units drunk over the two weeks was 27.61, just

below the recommended guidance which is 21 units a week for men and 14 units a week women.

4.1.3 Additional findings in relation to mood.

The results showed no relationship between either the FET AB or the HMET AB variables and mood, specifically measures of anxiety and depression. There was also no relationship found between drinking-related variables and measures of mood. Primarily, this could be explained by the fact this was a non-clinical sample and within the total sample 62.8% reported within normal levels of anxiety and 60.5% within normal levels of depression. The literature reports that alcohol use frequently occurs with other psychological disorders such as anxiety or depression. A systematic review looking at AB in clinical populations of patients with alcohol use disorders examined how psychological co-morbidity was managed (Sinclair, Nausheen, Garner, & Baldwin, 2010). Of 17 papers, 13 gave minimal or no consideration of the impact of co-morbidity and only four studies included some measure of current levels of mood or anxiety. Therefore, despite the high prevalence of co-morbid psychological distress in patients with alcohol use disorders and the impact that it has on aetiology, presentation and outcome, psychiatric co-morbidly has not been consistently measured or described in experimental studies on alcohol-related AB on clinical samples. It was, therefore, important that this study considered the impact of these factors, although there were no significant findings to report.

Further analysis, however, found some interesting relationships between mood-related variables and the FET fixation duration variables. Correlations were found between level of anxiety and the FET fixation duration alcohol and neutral variables suggesting that lower levels of anxiety were associated with increased

fixation duration for both neutral and alcohol stimuli, suggesting attentional processes may be impacted by levels of anxiety. Negative correlations were also found between depression scores and HMET total fixation duration to alcohol and non-alcohol related stimuli, suggesting that lower levels of depression were associated with increased fixation duration on alcohol and non-alcohol related stimuli. A medium negative correlation was also found between HMET visit count non-alcohol variable and level of depression, these results suggest that lower levels of depression were associated with more visits to non alcohol-related stimuli.

Previous research has suggested experimental induction of a negative mood leads to an increase in AB for alcohol-related cues (Field & Powell, 2007), however, this was only found within individuals who 'drink to cope' with stress. Field and Quigley (2009) found that participants who reported drinking alcohol to cope with negative affect showed increased AB to alcohol-related cues after stress induction. They suggested that the observed effects indicated stress increases both initial orientating toward, and delayed disengagement of, attention from alcohol-related cues. These results suggest that among social drinkers who drink to cope the experience of mild stress is likely to lead to changes in attentional processing of alcohol cues. The present study did not identify individuals who 'drink to cope' or use alcohol as a means to manage stress, low mood or anxiety so firm conclusions cannot be drawn in relation to the current study's findings.

4.2 Methodological Limitations

There are number of methodological limitations which should be carefully considered when reviewing these results.

There are implications in terms of generalisability of the findings of this study. This study recruited from a non-clinical, mainly female, white British, student population. The findings may have been different for male populations, heavy social drinkers, populations with a longer drinking history and clinical samples as well as individuals with dual diagnoses such as anxiety or depression. The population was also restricted in terms of the sample's educational status and it would be necessary to consider if education impacted upon any of the variables. An attempt was made to collate relevant demographic factors however several demographic variables were missing including relationship and housing status, as initially they had not been deemed to be pertinent to the current study. Although the study explored alcohol and drinking related behaviours, there was no specific screening of participants who identified themselves as regular or social drinkers of alcohol or abstainers. It is often assumed student populations will report higher levels of alcohol consumption than the general population; however, some participants within this study reported having drunk no alcoholic beverages during the two weeks prior to the study on the TLFB whilst others stated that they were not regular drinkers of alcohol. This might have significantly impacted upon the results and would need to be considered in any future research.

Due to the non-normally distributed nature of the data, non-parametric analyses were performed to examine relationships between the main study variables. Non-parametric tests do not allow for the researcher to 'control' for confounding factors and the interplay of other variables. In addition, the small sample size and cross-sectional design of this study means that it was only possible to obtain a 'snap-shot' of the relationship between the FET and HMET measures of AB within this sample. The small sample size also significantly impacted upon the primary analysis

of the FET and HMET data. Due to data reduction processes and technical issues only 35 sets of data were collected for the FET and 42 sets of data for the HMET. This led to only 35 complete data sets being available for primary analysis. This small sample size resulted in a large number of correlational analyses being conducted. Future research should use larger samples to allow for a more sensitive analytic approach. For example, factor analysis could be used to identify which of the many alcohol use measures shared variance. This would then allow composite alcohol use variables to be computed and correlated with AB, significantly reducing the number of correlations overall.

There are also several limitations associated with self-report measures of drinking behaviour. Retrospective diaries incorporating the TLFB are associated with underestimates of alcohol consumption, although incorporating beverage specificity into the TLFB can offset some of these difficulties (Feunekens, van't Veer, van Staveren, & Kok, 1999). Within this study participants were able to complete the TLFB either by reporting the number of alcohol units consumed per day or by detailing the quantity and type of beverage drunk each day, thus allowing for large inconsistencies in reporting of alcohol consumption across participants. Arguably, the accuracy of estimates could be improved by employing more objective indices, although evidence suggests that self-reporting of drinking behaviour is consistent with both physiological tests (Weiss et al., 1998) and reports by spouses (Booth, Dale, Slade, & Dewey, 1992). This study also suffered from missing data due to a lack of completion of TLFB items by some participants possibly due to social bias influences.

Self-report measures are also thought to be influenced by demand characteristics of the test situation and social desirability. Thus, participants may

have sought to give socially desirable responses to the TLFB, AUQ, AUDIT and mood related measures. The researcher also orally administered the initial demographic and screening questionnaire. This could have significantly impacted upon disclosure of demographic details as well as mental or physical health problems and cigarette use, although the assurance of confidentiality was aimed to minimise the effects. Both the AUQ and AUDIT are, however, widely used and well validated measures of alcohol use and craving, and a large body of literature has indicated good reliability and validity of both measures (Allen et al., 1997; Bohn et al., 1995; Fleming et al., 1991; Kokotailo et al., 2004; Saunders et al., 1993).

The power analysis suggested that 64 participants were required for the correlational analyses. However, only 43 data sets were collated, with only 35 complete data sets. There were a number of reasons for this. First, primary recruitment took place during the students' academic holidays and exams due to time pressures in relation to research deadlines. Second, whilst a large number of people expressed an interest in the study (N = 114), many made no further contact with the researcher (n = 27), cancelled (n =24) or did not attend (n = 10) without explanation. It could be assumed that some of these individuals may not have met the inclusion criteria however this cannot be confirmed. Lastly, many of the students participated in the hope of receiving Experimental Psychology Research (EPR) points towards their degree modules for participating in research, which may have contributed to participant's motivation to engage in the study and may have biased recruitment. Unfortunately, during the period of recruitment the deadline for achieving the target number of EPR points passed and interest in the study declined despite the offer of reimbursement. The small sample size and the use of non-parametric analyses, may also have eroded the study's power to detect effects, so there is a greater risk of a

(false negative) type II error that may explain some of the non-significant results. However, despite the small sample size the final sample size was comparable to sample sizes utilised within other studies within this research area. In addition, correlations between variables reported some medium effect sizes.

There were also several other methodological weaknesses that would need to be addressed in any future research. The debrief lacked the exploration of participants' urge to use alcohol once they had finished participation. This would be of particular concern with participants who reported high levels of craving, high levels of binge drinking, alcohol consumption and low mood or high anxiety. This would be even more concerning with individuals who were reimbursed for their participation. Any future research would need to consider incorporating these procedures to ensure effective management of potential risk. It would also be important to provide psycho-education explaining that use of alcohol can lead to, or worsen, anxiety and depression.

The research literature highlights the importance of certain factors in relation to AB. These factors include impulsivity and impaired inhibitory control and stress or 'escape drinking'. This study failed to use a measure of impulsivity or impaired inhibitory control given that its primary aim was to explore the relationship between the two measures of AB, however, future research could consider this given the literature indicates the its importance with respect to AB (Coskunpinar & Cyders, 2013; Field et al., 2010; Roberts et al., 2014).

This study did however incorporate measures of mood, although these measures did not explore levels of stress or 'escape drinking', and as such, examined different constructs to those within the existing research. The selected measures of

anxiety and depression were chosen due to the wide use of these measures within UK adult mental health services. They also demonstrate good criterion validity, internal consistency and test-retest reliability (Kroenke et al., 2001, 2010; Löwe et al 2008).

4.3 Theoretical Implications

Notwithstanding these limitations, some of the findings from this study have contributed to the existing literature in relation to current theoretical models. This study found that when utilising the FET measure of AB there were significant positive relationships between drinking, craving and AB. These findings provide further evidence for the motivational models of AB such as Robinson and Berridge's (1993, 2008) theory of incentive-sensitisation and Franken's (2003) extended neurobiological cognitive model.

The theories of Franken (2003), Robinson and Berridge (1993, 2008) and Ryan (2002) also suggest that AB for substance-related cues are associated with craving at that moment in time. This study also provides further evidence for this hypothesis. It is suggested that AB may increase the likelihood of alcohol use because an individual who is repeatedly distracted by alcohol cues in their environment would be more likely to experience alcohol craving and will act upon that craving and seek out alcohol (Field & Wiers, 2012; Field et al., 2014). This has important clinical implications.

4.4 Clinical Implications

A substantial and growing body of evidence over the past few years provides evidence of AB for alcohol-related stimuli in a variety of populations (Bruce & Jones, 2004; Cox et al., 2006; Field et al., 2004; Field & Wiers, 2012; Klein et al., 2013; Sharma et al., 2001; Stormark et al., 2000; Townshend & Duka, 2001). This study contributes to this body of evidence as it appears to demonstrate that AB as measured by the FET is associated with drinking and craving within a student population.

This study finds further evidence of the importance of AB in alcohol addiction and highlights the importance of addressing AB within clinical assessment and intervention. The findings suggest a need to ensure adequate assessment of current drinking behaviour and craving in the assessment of addiction and alcohol use disorders as they appear to be key mechanisms underlying AB and addiction. The use of measures such as the AUQ, AUDIT and TLFB could prove to be extremely useful as screening measures in the clinical domain. The current findings also provide further evidence that interventions affecting attention and implicit cognitions may be promising treatment options within addiction services. Recent research has explored the use of intervention approaches which are well suited to specifically targeting implicit cognitions such as mindfulness based interventions and ABM.

MBI's have been associated with reduced cognitive reactivity, decreased avoidance and rumination (Chiesa et al., 2011) which may be due to improvements in cognitive abilities such as attentional control (Chiesa et al., 2011; Lutz et al., 2008). Increased attentional control through mindfulness practice may therefore

enable individuals to illicit control over their implicit responses to substance-related cues. It is suggested that the practice of mindfulness meditation requires the development of four key abilities; sustained attention to a particular stimuli, the ability to monitor and detect when the mind might be wandering, the ability to switch attention or disengage from distracting stimuli and the ability to redirect attention to the chosen stimuli known as selective attention (Lutz et al., 2008).

Trait mindfulness is the ability to attend to a present moment situation enabling increased awareness of automatic reactions thus resulting in a non-reactive response to distressing thoughts, emotions and sensations (Chambers, Gullone, & Allen, 2009). Trait mindfulness demonstrates plasticity and it has been found to be enhanced by MBI's (Carmody & Baer, 2008, Chambers et al., 2009; Garland, 2011). Research has indicated that the practice of mindfulness can lead to significant increases in trait mindfulness (Garland et al., 2010) and evidence suggests positive relationships between trait mindfulness and self-reported attentional control, improved selective attention, decreased errors on sustained attention tasks, and increase in attentional re-orientating capacity (Garland, 2011; Garland et al., 2014).

These findings have important implications for the use of MBI's with individuals with AUD's. Studies have suggested that treated alcohol dependent users' can benefit from the development of trait mindfulness (Garland, 2011; Garland et al., 2014). Garland and colleagues (2014) have suggested that individuals with high levels of trait mindfulness may have greater ability to control their attentional responses to substance-related cues, for example being able to disengage their attention, and have suggested that low trait mindfulness may enhance the risk of addictive urges, automatic appetitive processes and attentional fixation on alcohol cues i.e. AB (Garland, Boettiger et al., 2012). The evidence also suggests that trait

mindfulness is something that can be developed through mindfulness practice. Garland (2011) and Garland and colleagues (2014) have demonstrated that individuals being treated for alcohol dependency may be able to be trained to develop trait mindfulness through mindfulness practice, thus enabling them to successfully regulate the impact of underlying implicit processes such as AB through increased attentional control (Garland et al., 2014).

Therefore the evidence suggests that mindfulness training may strengthen the capacity for individuals to regulate attentional control in the face of conditioned stimuli associated with substance use, countering AB by refocusing and re-directing attention away from substance-related cues and toward innocuous stimuli (Garland et al., 2014). It is also suggested that MBI's may also impact addiction by clarifying cognitive appraisals and altering negative emotions which in turn reduces perseverative cognitions and emotional arousal (Garland et al., 2014). MBI's may also enhance awareness of meta-cognitive processes that regulate drug-use schema (Garland, Boettiger et al., 2012; Garland et al., 2014; Kabat-Zinn, 2003). In addition, the practice of mindfulness may also promote extinction learning (Garland, Franken, & Howard, 2012; Garland et al., 2014), reduce cue-reactivity, increase individual's cognitive control over craving, calm physiological stress reactivity through the activation of the parasympathetic nervous system and restore the natural reward processing mechanisms (Garland et al., 2014).

Another effective treatment approach may be ABM. Research to date has provided mixed findings, with some studies demonstrating that manipulation in attention can lead to changes in heavy drinkers' AB (Field et al., 2007; Field & Eastwood, 2005; Schoenmakers et al., 2007), whilst other studies have suggested otherwise (Field et al., 2007; Schoenmakers et al., 2007). Fadardi and Cox (2009)

found that harmful drinkers had larger alcohol AB than hazardous or social drinkers and that attentional training reduced hazardous and harmful drinkers' alcohol AB. In addition, they provided evidence that harmful drinkers showed post-training reductions in alcohol consumption, these improvements were maintained at three months follow up.

Christiansen and colleagues (2015) have also suggested that ABM may reduce the risk of substance use if measured and administered in settings where the substance use normally occurs. ABM has been administered in a participant's home environment using a computer and a home-based alcohol specific attention modification program (Mc Geary et al., 2014). Results have indicated that attentional training in naturalistic environments may have significant impacts upon the processes of AB, which in turn impacts upon drinking behaviour. This research is worthy of further exploration given the importance in using effective and ecologically valid measures of AB. Further evidence of this kind could provide a greater understanding of effective home-based and internet-based interventions. This would have significant implications for the provision of cost-effective and accessible therapeutic interventions for alcohol use disorders.

4.5 Further Research

The findings of this study highlight a number of possible areas of future investigation to increase theoretical understanding and to overcome the methodological limitations of this study.

The first areas of consideration for future research would be regarding the target population and recruitment methodology. It would be desirable to include a greater ratio of male participants as well as participants who reflect a wider range of ethnic backgrounds. It would also be important to ensure that participants are regular drinkers but also include people practicing abstinence or not identifying themselves as 'social drinkers', as differing results have been found in relation to AB across different drinking populations (Cox et al., 2007; Fardardi & Cox, 2008; Field et al., 2007; Schoemakers et al., 2007; Stormark et al., 1997; Townsend & Duka, 2007). It would be pertinent to consider using a clinical and control sample and consider investigating individuals at different stages of treatment.

This study did not provide evidence of AB for alcohol-related cues with a HMET, however, it is possible that this was due to the methodological issues described. In order to overcome this issue two methodological changes could be applied. First, participants could complete all necessary self-report measures and equipment calibration procedures prior to entering the bar-laboratory, meaning they would only be exposed to the environmental stimuli once the test conditions had begun. This would enable their eye gaze to be tracked from the first moment of entering the bar-laboratory. Second, 3D virtual technology could be used within a laboratory environment. This would allow for greater control over the environmental stimuli and duration of exposure to stimuli, which may allow for a more sophisticated and accurate tracking of eye gaze and investigation of AB processes at different durations of exposure to stimuli. This would enable greater ecological validity without compromising methodological robustness. It would also enable further investigation in relation to the impact of stimuli complexity in the measurement of AB (Miller & Fillmore, 2010). Utilising this virtual reality approach

in combination with neurocognitive measures could lead to further findings, although it would be costly to achieve in both a research and clinical capacity.

This study also did not consider several important features that have been highlighted as being important in the investigation of AB; impulsivity and impaired inhibitory control, stress and expectancy. Neurobiological theories of addiction suggest a moderating role for impulsivity or weak executive control in the development of addiction for example within the incentive-sensitisation model (Robinson & Berridge, 1993, 2008). It is suggested that the relationship between impulsivity, executive dysfunction and alcohol use is bidirectional (Field & Cox, 2008; Field & Wiers, 2012). Future research should consider incorporating measures of impulsivity and inhibitory control to explore these processes in relation to the HMET measures of AB.

In a recent review of craving and AB, Field and colleagues (2014) suggest that there is a small but robust association between craving and AB and that the magnitude of the relationship increases when attention is measured directly (e.g. eye movements) rather than indirectly (e.g. Stroop task). The current study supports this prediction in relation to the FET, however no relationship was found between the HMET measure of AB and measures of craving. Due to the methodological flaws of the current study it is difficult to draw any firm conclusions from this finding and further exploration of the relationship between these measures is required.

Evidence suggests stress is another important factor within the process of AB. For individuals who 'drink to cope' with stress, the introduction of a negative mood leads to an increase in AB for alcohol-related cues (Field & Powell, 2007). Other studies have shown increased AB to alcohol-related cues after stress induction

(Field & Quigley, 2009). While this study included measures of mood, no relationship was found between the measures of anxiety and depression and measures of AB. It is possible this is because these measures are 'tapping into' differing constructs. Other measures may be more pertinent when exploring stress in relation to AB. Future research may want to consider utilising measures that consider the specific construct of stress, such as the Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983) or The Escape Questionnaire (Cahalan, Cisin, & Crossley, 1969) which determine the extent to which individuals consume alcohol to reduce stress and dysphoric feelings.

Drug expectancy has also been proposed as an important factor in the development of AB (Field & Cox, 2008). The current literature suggests that substance users show AB for substance-related stimuli and experience craving when they become alert to the fact that the presence of a substance-related stimuli in their environment may lead to the opportunity to use the substance. This results in expectations related to the availability of a substance (Hogarth & Duka, 2006). AB and subjective craving may also occur when individuals are in the presence of substance-related cues within a situation or environment in which substance use may be expected e.g. in a pub (Wertz & Sayette, 2001). Field and Cox (2008) proposed model suggests that drug expectancy is important in determining the degree of AB. They propose that substance-paired stimuli leads to subjective craving because they take hold of an individual's attention due to an expectation the substance will be available to consume. Field and Cox (2008) propose that once the conditioning process occurs substance-paired stimuli will keep triggering an expectancy regarding the availability of the substance, which in turn increases the power of the substance-related stimuli to grab an individual's attention and cause craving. Other results

suggest that the anticipation of reward produces a general, rather than outcome-specific enhancement of AB for reward-related stimuli (Jones et al., 2012). Expectancy was not explored within the current study, however it would be interesting to explore this phenomenon further in relation to the HMET measure of AB.

The areas described above require further exploration. The use of the HMET may provide some interesting additional evidence once the methodological issues are resolved.

4.6 Conclusion

This study showed that in a small sample of university students there was no relationship between two measures of AB the FET and the HMET. The findings of this study also showed no relationship between HMET measure of AB and measures of drinking or craving. There was also no relationship between the FET or HMET AB variable and measures of mood. The FET measure of AB was, however, found to correlate with some of the current drinking related variables and craving. These findings support previous research and existing motivational models of AB and addiction. The findings highlight the need for more research utilising the HMET due to the methodological limitations of this study. It would also be pertinent to consider further research across a range of populations and include other measures that capture key factors identified in the literature as affecting AB, such as impulsivity, inhibitory control and stress.

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Appendix 1

List of Keyword Searches and Number of Hits for Literature Review

Databases Searched

MEDLINE, PsycINFO, Scopus and Web of Science

Search Terms Used in Literature Search

Attentional bias	**AND**	**Addiction**
OR		**OR**
Cognitive bias		**Alcohol***
OR		**OR**
Attention*		**Drinking**
OR		**OR**
Stroop		**Social drinkers**
OR		**OR**
Visual probe		**Hazardous drinkers**
OR		**OR**
Dot probe		**Addictive behaviour**

		Number of hits			
		MEDLINE	**Scopus**	**PsycINFO**	**Web of Science**
Attentional bias	Addiction	97	153	218	378
	Alcohol*	119	151	180	420
	Drinking	137	97	80	167
	Social drinkers	36	40	40	134
	Hazardous drinkers	3	5	3	14
	Addictive behaviour	52	64	66	106
Cognitive bias	Addiction	90	168	206	334
	Alcohol*	163	243	198	449
	Drinking	174	101	70	199
	Social drinkers	19	23	24	81
	Hazardous drinkers	3	5	2	12
	Addictive behaviour	49	52	53	84
Attention*	Addiction	1498	4231	4241	15384
	Alcohol*	1498	12149	5697	33760
	Drinking	9200	4403	1359	12219
	Social drinkers	191	224	192	416
	Hazardous drinkers	20	25	14	41
	Addictive behaviour	505	631	529	1009
Stroop	Addiction	78	130	253	360
	Alcohol*	154	200	245	442
	Drinking	173	82	70	142
	Social drinkers	20	21	24	53
	Hazardous drinkers	2	2	2	5
	Addictive behaviour	34	39	52	60
Visual probe	Addiction	30	37	56	80
	Alcohol*	57	68	50	137
	Drinking	98	46	21	74
	Social drinkers	14	16	15	30
	Hazardous drinkers	0	0	0	0
	Addictive behaviour	13	15	11	0
Dot probe	Addiction	13	25	34	50
	Alcohol*	41	75	21	197
	Drinking	152	28	10	75
	Social drinkers	5	5	6	11
	Hazardous drinkers	0	0	0	0
	Addictive behaviour	7	9	14	11

Appendix 2

DSM-5 Classification of Alcohol Use Disorder

DSM-5		
1	Alcohol is often taken in larger amounts or over a longer period than was intended.	
2	There is a persistent desire on unsuccessful efforts to cut down or control alcohol use.	
3	A great deal of time is spent in activities necessary to obtain alcohol, use alcohol, or recover from its effects.	
4	Craving, or a string desire or urge to use alcohol.	
5	Recurrent alcohol use resulting in a failure to fulfil major role obligations at work, school, or home.	The presence of at least 2 of these symptoms indicates an Alcohol Use Disorder (AUD). The severity of the AUD is defined as: **Mild:** The presence of 2 to 3 symptoms **Moderate:** The presence of 4 to 5 symptoms **Severe:** The presence of 6 or more symptoms
6	Continued use despite having persistent or recurrent social or interpersonal problems caused or exacerbated by the effects of alcohol.	
7	Important social, occupational, or recreational activities are given up or reduced because of alcohol use.	
8	Recurrent alcohol use in situations in which it is physically hazardous.	
9	Alcohol use is continued despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by alcohol.	
10	Tolerance, as defined by either of the following: a) A need for markedly increased amounts of alcohol to achieve intoxication or desired effect b) A markedly diminished effect with the continued use of the same amount of alcohol	
11	Withdrawal, as manifested by either of the following: a) The characteristic withdrawal syndrome for alcohol (refer to criteria A and B or the criteria set for alcohol withdrawal) b) Alcohol (or closely related substance, such as benzodiazepine) is taken to relieve or avoid withdrawal symptoms.	

Appendix 3

Copy of University of Liverpool Ethical Approval

Appendix 4

Correspondence Regarding Research Proposal Approval

Appendix 5

Recruitment Poster and Online Recruitment Announcement

Volunteers required for alcohol study

Study title: Attention and Environment

We are seeking volunteers to take part in a psychology experiment investigating attentional processes across environments.

Volunteers are required to attend laboratories in the School of Psychology, on the University of Liverpool campus, for one experimental session which will last approximately 45 minutes.

During the experiment, participants will be asked to complete a few simple tasks and self report questionnaires.

In order to take part, you should be aged between 18 and 30 years, and a fluent English speaker. If you are a psychology student, you can claim EPR points (1 for every 10 minutes), for further information and reimbursement details please contact the researcher.

If interested, please contact *Sarah Dutton* at ..... or contact on ……..

Appendix 6

E-mail Response to Interested Individuals

Hello,

Thank you for contacting me regarding the study titled: Attention and Environment.

I have attached the Participant Information Sheet to this email. The Participant Information Sheet includes important details on the inclusion/exclusion criteria for participants and contains information about what the study involves. Please read this carefully before agreeing to take part.

If, after reading the information sheet, you wish to take part, please let me know and we can book in a session. **Please note the study only takes place on Monday afternoons.** I have various sessions that run between 1pm and 6pm, the session will last approximately 45 minutes.

If you are still interested in taking part after reading the participant information please contact me and I can let you know what slots I have available.

When you attend your session I will meet you at your chosen time at the Eleanor Rathbone Building foyer (at the lift) to take you to the laboratory.

If you are a psychology student, you can claim EPR points (1 for every 10 minutes) **alternatively** you can receive £5 as a reimbursement for your time.

Please can let me know if you are claiming EPR points or require re-imbursement in advance.

If you have any other questions please let me know.

Regards

Sarah Dutton
Trainee Clinical Psychologist

If you have any further questions please contact the principal investigator:

e: .....

Tel: ……..

Appendix 7

Participant Information Sheet and Consent Form

UNIVERSITY OF LIVERPOOL

Study Title: Attention and Environment

Participant Information Sheet

You are being invited to participate in a research study. Before you decide whether to participate, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and feel free to ask us if you would like more information or if there is anything that you do not understand. Please also feel free to discuss this with your friends, relatives and GP if you wish. We would like to stress that you do not have to accept this invitation and should only agree to take part if you want to.

Thank you for reading this.

1. What is the purpose of the study?

We are interested in the relationship between attentional processes and environment

2. Why have I been chosen to take part?

We are recruiting 64 healthy volunteers who fulfil the following criteria

1. Are aged between18 and 30 years
2. Fluent English speaker
3. Provide an alcohol breathalyser reading of 0.0 mg/l. We will ask you to provide a breathalyser reading before starting the experiment to ensure you have not consumed any alcohol prior to testing.
4. Your vision is within the normal ranges or you wear contact lenses to correct your vision.

If you meet these criteria, then you are eligible to take part. However, you **CANNOT take part if you meet any of the following criteria:**

1. Have ever received treatment for an alcohol or drug problem, or if you are currently seeking such treatment or trying to cut down how much alcohol you drink.
2. Are over the age of 30 years.
3. Provide an alcohol breathalyser reading of above 0.0 mg/l on the day of testing
4. You need to wear glasses to correct your vision.

3. Do I have to take part?

No. Participation in this research is completely voluntary. You are free to withdraw at anytime without explanation and without incurring a disadvantage.

4. What will happen if I take part?

If you agree to take part in the study, we will ask you to participate in a single experimental session. During the session, the researcher (Sarah Dutton) will ask you to complete some questionnaires and simple attention tasks. Each questionnaire will take less than 5 minutes to complete, each attention task will take less than 10 minutes.

The session will last approximately 45minutes.

Throughout the experiment, we would ask that you have your mobile phone switched off as it may interfere with some of the testing equipment.

5. Expenses and / or payments

If you are a psychology student, you can claim EPR points (1 for every 10 minutes) **alternatively** you can receive £5 as a reimbursement for your time.

6. Are there any risks in taking part?

There are no anticipated risks to you if you take part in the study.

7. Are there any benefits in taking part?

There are no direct benefits from taking part in this study however you may receive up to 5 EPR points **or** £5 to reimburse your time.

8. What if I am unhappy or if there is a problem?

If you are unhappy, or if there is a problem, please feel free to let us know by contacting Professor Matt Field (0151-794-1124) and we will try to help. If you remain unhappy or have a complaint which you feel you cannot come to us with then you should contact the Research Governance Officer on 0151 794 8290 (ethics@liv.ac.uk). When contacting the Research Governance Officer, please provide details of the name or description of the study (so that it can be identified), the researcher(s) involved, and the details of the complaint you wish to make.

9. Will my participation be kept confidential?

Yes, all of your data will be confidential. You will be assigned a random 'participant number', none of your personal detail will be kept with your data. Therefore, all data is anonymous. Data will be collected through questionnaires and tasks. Data will be stored on password protected computers which are stored in locked offices/laboratories. In most instances, your data will be used for this study only, however, some research requires we submit data sets to public data stores. People can request access and use of this data for future research purposes. Such data stores can keep data indefinitely. If data is to be destroyed, this will be done through confidential waste disposal services. The researcher will abide by the Data Protection Act (1988). Data is stored in line with the University of Liverpool guidelines. The named data custodian is Professor Matt Field.

In the unlikely event of a serious or adverse event it may be necessary for the researcher to contact someone in order to address any health or safety issues.

10. Will my taking part be covered by an insurance scheme?

Participants taking part in a University of Liverpool ethically approved studies will have cover.

11. What will happen to the results of the study?

All the information collected about you during the course of the research will be anonymised. No personal information will be disclosed to anyone.

We intend to publish the results from this study in a scientific journal. However, any information which you provide will be stored completely anonymously (with a random number), and you will not be identified in any publication.

For some research, we are obliged to submit complete data sets of public data stores. However, no personal information is included in these data sets, and all data is anonymised. Nothing can be traced back to you.

If you are interested in your own results, or the results of the study, please let us know and we will make the data available to you.

12. What will happen if I want to stop taking part?

You are under no obligation to take part in this study; it is completely your choice. If you do decide to take part, you are free to withdraw at any time and without giving any reason or explanation.

Data collected up until the period you withdraw may be used, but only if you are happy for this to be done. Otherwise you may request that your data be destroyed and no further use is made of them.

13. Who can I contact if I have further questions?

Please contact the principle investigator:

……..

Appendix 8

Screening Questionnaire and Demographic Information Sheet

UNIVERSITY OF LIVERPOOL

Demographic & Screening Questions

Participant Number _____

Age _____

Gender (please circle) M / F

Ethnicity _____

Breath alcohol reading _____ **mg/l**

Current or historical drug or alcohol dependency (please circle) **Y/N**

Current acute mental health problem (please circle) **Y/N**

(Mental health problems_____)

Current acute physical health problem (please circle) **Y/N**

(Physical health problems_____)

Medication? Y/N **Details** _____

Age leaving education/highest level of education _____

Employment status _____

Smoker Y/N **If Y number of cigarettes a day** _____

Appendix 9

The Time Line Follow Back (TLFB) Method

Appendix 10

Alcohol Urge Questionnaire (AUQ)

Appendix 11

The Alcohol Use Disorders Identification Test (AUDIT)

Appendix 12

The Patient Health Questionnaire-9 (PHQ-9)

Appendix 13

The Generalised Anxiety Scale-7 (GAD-7)

Appendix 14

Localisation and Scenario Task

Localisation Task **Participant number**_____

Please respond to these questions using the locations: Left, Centre and Right. Top shelf, middle shelf and bottom shelf.

For example, if I were to ask you where is the 7up? You should response, centre, middle shelf.

Alcohol related Questions

Can you tell me where the Carlsberg is?	
Can you tell me where the Archers is?	
Can you tell me where the white wine is?	

Soft Drink related Questions

Can you tell me where the big bottle of lemonade is?	
Can you tell me where the J20's are?	
Can you tell me where the Fanta is?	

Please respond to these questions as honestly as possible.

Neutral Questions

Out of all of the drinks available which would you be most likely to consume of a Friday evening?	
Out of all of the drinks available which would you be most likely to consume of a Monday morning?	
What drink would you most like to consume right now?	
If you were given a glass with some vodka in it, what mixer would you like to add to it?	

Scenario Task

You will be presented with 2 different scenarios. You will have £100 budget for each one. From the drinks available you must decide what you would like to use in the scenario.

Scenario A:

You have £100 budget to buy drinks to host a dinner party. The party will be for 9 more people, that is 10 people in total including yourself. The full £100 is to be spent on any drinks of your choice. The list of prices is on the board.

Scenario B:

You have £100 budget to buy drinks to host a charity event in aid of rescuing animals from bad homes. The event will host 25 people in total including you. The full £100 is to be spent on any drinks of your choice. The list of prices at a lower wholesale price is on the board.

Appendix 15

Participant Debrief Sheet

UNIVERSITY OF LIVERPOOL

PARTICIPANT DEBRIEFING INFORMATION

Title of Research: Attention and Environment

Thank you for participating in this study

What was the study about?

The aim of this study was to investigate attentional bias for alcohol cues in different environments. Attentional bias for alcohol cues is seen in hazardous drinkers. Treatments have been developed to try to reduce this bias. However, these biases have been measured through computer tasks and we don't know if this relates to every day attentional measures. We want to see if an attentional bias for alcohol cues on the dot-probe task correlates with natural attentional processes in the bar-lab. We hope that the findings of this research will further our understanding of the way in which drinking behaviour affects our attentional processes and how these effects may relate to alcohol consumption.

What if I want advice about drinking, or help with reducing my drinking?

We are not qualified to offer advice ourselves, but if you are concerned about your drinking, and would like help giving up, we advise you to seek information and advice from your Doctor, by calling Drinkline on 0800 917 82 82, or from one of the following websites:

www.drinkaware.co.uk
http://www.nhs.uk/change4life/Pages/alcohol-health-harms.aspx
http://www.nhs.uk/Livewell/alcohol/Pages/Alcoholsupport.aspx
http://www.talktofrank.com/

If you would like to receive further free information leaflets around alcohol or drug use please ask the researcher for further details.

Who can I contact if I have further questions?

If you have any questions then please contact the principle investigator:

…….

Appendix 16

Kolmogorov-Smirnov and Shapiro-Wilk Tests for Normality of Distribution of the Primary Raw Data Set and Logarithm and Square Root Transformed Data Set

Raw Data Set - Results of Tests of Normality

NON- NORMALLY DISTRIBUTED	Skewness	SE Skewness	Z score	Kurtosis	SE Kurtosis	Z score	Kolmogorov-Smirnov	Shapiro-Wilk
GAD -7	0.866	0.361	2.398891966759	0.307	0.709	0.433004231311707	0.002	0.01
PHQ -9	0.723	0.361	2.00277008310249	-0.651	0.709	-0.918194640338505	0	0.01
AUQ Time 1	1.302	0.361	3.60664819944598	0.813	0.709	1.14668547249647	0	0
AUQ Time 2	1.562	0.361	4.32686980609418	2.619	0.709	3.69393511988717	0	0
Alcohol composite score	0.001	0.361	0.00277008310249307	-0.759	0.709	-1.07052186177715	0.092	0.029
Attentional bias - FET	-1.267	0.398	0.00277008310249307	6.422	0.778	8.25449871465296	0.4	0
Attentional bias- HMET	-3.806	0.365	-10.427397260274	19.672	0.717	27.4365411436541	0	0
Total fixation duration -Alcohol free (FET)	1.02	0.365	2.79452054794521	0.782	0.717	1.09065550906555	0.015	0.003
Total Fixation Duration- Non-Alcohol (HMET)	2.665	0.365	7.3013698630137	12.188	0.717	16.9986052998605	0.036	0
1st fixation - Alcohol free (HMET)	1.116	0.365	3.05753424657534	1.715	0.717	2.39191073919107	0.009	0.003
1st Fixation Non-Alcohol (HMET)	1.017	0.365	2.78630136986301	2.034	0.717	2.83682008368201	0.107	0.017
TLFB - Drinking days 2 weeks	0.051	0.361	0.141274238227147	-0.753	0.709	-1.06205923836389	0.035	0.011
TLFB No of units 2 weeks	1.055	0.361	2.92243767313019	0.873	0.709	1.23131170662906	0.034	0
TLFB Binge 2 weeks	1.049	0.361	2.90581717451524	0.742	0.709	1.04654442877292	0	0
TLFB Units/hour	2.438	0.365	6.67945205479452	7.31	0.717	10.1952580195258	0	0
TLFB No of times drunk in 6 months	1.172	0.374	3.13368983957219	50.9487	0.733	69.5070941336971	0.001	0
TLFB Frequency drunk	-0.0413	0.378	-0.109259259259259	-0.413	0.741	-0.557354925775978	0	0.001
TLFB Age regularly began drinking	1.221	0.398	3.0678391959799	2.712	0.768	3.53125	0	0.001
TLFB Average Units 2 weeks	0.389	0.361	1.07756232686981	-0.803	0.709	-1.13258110014104	0.2	0.02
TLFB Total days Abs 2 weeks	-0.616	0.361	-1.70637119113573	0.479	0.709	0.675599435825106	0.173	0.006

Raw Data Set - Results of Tests of Normality

NORMALLY DISTRIBUTED	**Skewness**	**SE Skewness**	**Z score**	**Kurtosis**	**SE Kurtosis**	**Z score**	**Kolmogorov-Smirnov**	**Shapiro-Wilk**
AUDIT	0.083	0.361	0.229916897506925	-1.043	0.709	-1.47108603667137	0.2	0.087
FET neutral	0.338	0.398	0.849246231155779	-0.7	0.778	-0.89974293059126	0.2	0.725
FET alcohol	0.541	0.398	1.35929648241206	0.85	0.778	1.09254498714653	0.2	0.366
Total Fixation Duration Alcohol (HMET)	-0.654	0.365	-1.79178082191781	-0.01	0.717	-0.0139470013947001	0.2	0.47
1st Fixation Alcohol (HMET)	0.891	0.365	2.44109589041096	1.392	0.717	1.94142259414226	0.2	0.075
Visit Count - Alcohol (HMET)	0.193	0.365	0.528767123287671	0.225	0.717	0.313807531380753	0.2	0.621
Visit Count - Non- Alcohol (HMET)	-0.262	0.365	1.33150684931507	-0.499	0.717	-0.695955369595537	0.2	0.814
Visit Count- Alcohol Free (HMET)	0.486	0.365	1.33150684931507	-0.15	0.717	-0.209205020920502	0.193	0.336
TLFB Age first drunk	-0.044	0.369	-0.119241192411924	0.25	0.724	0.345303867403315	0.13	0.201

Square Root Transformed Data of Non-Normally Distributed Variables - Results of Tests of Normality

	Skewness	SE Skewness	Z score	Kurtosis	SE Kurtosis	Z score	Kolmogorov-Smirnov	Shapiro-Wilk
GAD-7	-0.0692	0.361	-0.191689750692521	0.135	0.709	0.190409026798307	0.022	0.018
PHQ-9	-0.463	0.391	-1.18414322250639	0.1	0.709	0.141043723554302	0.063	0.027
AUQ Time 1	0.9	0.361	2.49307479224377	-0.176	0.709	-0.248236953455571	0.013	0
AUQ Time 2	0.861	0.361	2.38504155124654	0.012	0.709	0.0169252468265162	0.028	0.001
Alcohol composite score	-0.585	0.361	-1.62049861495845	-0.94	0.709	-1.32581100141044	0	0.001
Attentional bias - (FET)	0.319	0.398	0.801507537688442	3.851	0.778	4.94987146529563	0.02	0.003
Attentional bias- (HMET)	-0.521	0.365	-1.42739726027397	2.744	0.717	3.82705718270572	0.012	0.006
Total fixation duration -Alcohol free (HMET)	-0.333	0.365	-0.912328767123288	-0.453	0.717	-0.631799163179916	0.191	0.573
Total Fixation Duration Non-Alcohol (HMET)	-0.454	0.365	-1.24383561643836	1.079	0.717	1.50488145048815	0.2	0.088
Ist fixation - Alcohol free (HMET)	-3.616	0.365	-9.90684931506849	1.7607	0.717	2.45564853556485	0	0
1st Fixation Non-Alcohol (HMET)	-1.301	0.365	-3.56438356164384	4.283	0.717	5.97350069735007	0	0
TLFB - Drinking days 2 weeks	-0.715	0.361	-1.98060941828255	-0.825	0.709	-1.16361071932299	0	0
TLFB No of units 2 weeks	-0.778	0.361	-2.15512465373961	0.5038	0.709	0.710578279266573	0	0
TLFB Binge 2 weeks	0.013	0.361	0.03601108033241	-1.284	0.709	-1.81100141043724	0	0.001
TLFB Units/hour	0.174	0.365	0.476712328767123	1.01	0.717	1.40864714086471	0.005	0.067
TLFB No of times drunk in 6 months	-0.365	0.374	-0.975935828877005	-0.953	0.733	-1.30013642564802	0.162	0.016
TLFB Frequency drunk	-1.889	0.378	-4.9973544973545	4.037	0.741	5.44804318488529	0	0
TLFB Age regularly began drinking	0.712	0.393	1.8117048346056	1.819	0.768	2.36848958333333	0.002	0.006
TLFB Average Units 2 weeks	0.398	0.361	1.10249307479224	2.2	0.34257	6.42204512946259	0.006	0
TLFB Total days Abs 2 weeks	-0.616	0.361	-1.70637119113573	0.479	0.709	0.675599435825106	0	0

	Skewness	SE Skewness	Z score	Kurtosis	SE Kurtosis	Z score	Kolmogorov-Smirnov	Shapiro-Wilk
GAD-7	-0.429	0.361	-1.18836565096953	0.157	0.709	0.221438645980254	0.108	0.087
PHQ-9	-0.172	0.361	-0.476454293628809	-0.113	0.709	-0.159379407616361	0.005	0.043
AUQ Time 1	0.996	0.361	2.7590027700831	0.047	0.709	0.0662905500705219	0.008	0
AUQ Time 2	1.039	0.361	2.8781163434903	0.587	0.709	0.827926657263752	0.013	0
Alcohol composite score	-0.318	0.361	-0.880886426592798	-0.969	0.79	-1.22658227848101	0.011	0.009
Attentional bias (FET)	0.779	0.398	1.9572864321608	4.923	0.778	6.32776349614396	0.034	0.001
Attentional bias (HMET)	1.639	0.365	4.49041095890411	7.16	0.717	9.9860529986053	0.018	0
Total fixation duration -Alcohol free (HMET)	0.112	0.365	0.306849315068493	-0.387	0.717	-0.539748953974895	0.2	0.894
Total Fixation Duration Non-Alcohol (HMET)	0.651	0.365	1.78356164383562	2.969	0.717	4.14086471408647	0.2	0.024
Ist fixation - Alcohol free (HMET)	-0.597	0.365	-1.63561643835616	3.827	0.717	5.33751743375174	0.2	0.004
1st Fixation Non-Alcohol (HMET)	0.3	0.365	0.821917808219178	1.503	0.717	2.09623430962343	0.2	0.253
TLFB - Drinking days 2 weeks	-0.827	0.361	-2.29085872576177	-0.611	0.709	-0.861777150916784	0	0
TLFB No of units 2 weeks	-0.2	0.361	-0.554016620498615	-0.827	0.709	-1.16643159379408	0.026	0.006
TLFB Binge 2 weeks	-0.04	0.361	-0.110803324099723	-1.172	0.709	-1.65303244005642	0	0.001
TLFB Units/hour	0.707	0.365	1.93698630136986	2.185	0.717	3.04741980474198	0.001	0.004
TLFB No of times drunk in 6 months	0.245	0.374	0.655080213903743	-0.897	0.733	-1.2237380627558	0.2	0.081
TLFB Frequency drunk	-0.281	0.378	-0.743386243386243	-0.478	0.741	-0.645074224021592	0.05	0.006
TLFB Age regularly began drinking	0.955	0.393	2.43002544529262	2.183	0.768	2.84244791666667	0.002	0.002
TLFB Average Units 2 weeks	-0.541	0.361	-1.49861495844875	-0.864	0.709	-1.21861777150917	0.009	0.001
TLFB Total days Abs 2 weeks	-0.148	0.361	-0.409972299168975	-0.606	0.709	-0.854724964739069	0.004	0.006