

**The influence of groups and alcohol consumption on  
individual risk-taking**

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## I. Declaration

I declare that this thesis is my own work carried out under the normal terms of supervision. I confirm that this work has not been submitted for any comparable academic award.

Signed: 

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## VII. Abstract

**Background:** Up until now research investigating alcohol and risk-taking has largely overlooked influences from the social settings in which drinking usually occurs. The thesis therefore examines systematically, risk-taking as a determinant and consequence of alcohol consumption, whilst addressing the independent and combined influences of social contexts. **Method: Study 1** –Participants completed online surveys measuring trait impulsivity, risk-taking propensity, and alcohol use behaviours. **Study 2** – General risk-taking and computer simulated risky driving were measured before and following 0.6g/kg of alcohol or placebo administration in isolation or in natural friendship groups.

**Study 3** – Risk-taking was assessed in isolation or in natural friendship groups, following 0.8g/kg of alcohol or placebo consumption. Risk-taking behaviour was measured via The Shuffleboard Game, developed to examine physical risk-taking more akin to real world drinking games. Affective state was further measured both before and after beverage consumption. **Study 4** –Intoxication levels, experienced alcohol-related consequences, relative injunctive norms, and risky gambling, were measured in real world alcohol and non-alcohol-related environments. Group size data were also collected. **Meta-analysis** – A systematic search of Web of Science, PsycINFO and PsycARTICLES, revealed 22 ( $k = 35$ ) alcohol administration studies measuring risky behaviour. **Results:** Study 1 found both impulsivity and risk-taking predicted 8-11% of variance in hazardous and harmful alcohol use, and dependence symptoms, and 10-14% when combined. Results suggested some overlap between impulsive and risk-taking traits, yet still supported them as distinct constructs. In Study 2, those who were tested in group contexts were riskier on both general and driving-related tasks, than those in isolation. However, no effect of alcohol or interaction of intoxication and group was found on risky behaviour. Conversely, in Study 3, both alcohol and group contexts were found to independently increase risky behaviour on The Shuffleboard Game, although

no interaction of beverage and context was revealed. Further, a more positive mood predicted increased risk-taking behaviour. Study 4 revealed no influence of environment (alcohol versus non-alcohol), intoxication levels or injunctive norms on risky gambling, whereas larger group size was associated with riskier lottery choice in non-alcohol-related environments only. Furthermore, injunctive norms predicted experience of risky alcohol consequences, and were riskier in alcohol-related settings. Finally, the meta-analysis found a small, yet significant effect of acute alcohol consumption on risky behaviours, and more specifically on risky driving and gambling. However, alcohol was not found to influence risk-taking on general (non-specific) risk-taking tasks. **Overall conclusions:** Overall it was found that social contexts consistently increase individual risky behaviour, whereas alcohol effects on risk-taking are contingent on the risk domain measured. The lack of a combined influence of intoxication and groups highlights the importance of targeting social influences and perceived injunctive norms alongside alcohol consumption to reduce risky behaviour in drinking settings. Moreover, the varied effects of alcohol across risk domains outlines important implications for future research assessing risk-taking. Finally, the thesis finds risk-taking to be a predictor of alcohol consumption behaviours therefore, identifying potential risk-factors to address when attempting to reduce problematic alcohol consumption. **Original contribution:** The experimental research is the first of its kind to experimentally measure both the influence of alcohol and group contexts on *individual* risk-taking, as opposed to a collective group decision. Further, the thesis offers new insights into the effect of alcohol consumption on risk-taking as findings suggest variations of intoxication influences across risk-domains. Finally, the thesis contributes a newly developed measure of risky behaviour which potentially demonstrates risk-taking more akin to real-world drinking.

# Chapter 1 Introduction

## Alcohol and Risk-Taking

Throughout history, alcohol has been used by humans for psychological and social benefits (Heath, 2000; McGovern, 2011), and it continues to form the basis of many social, cultural and religious events (Gordon, Heim, & MacAskill, 2012). Whether it be several beers at a birthday celebration or a glass of wine with dinner, for many people alcohol is a consistent feature in many parts of everyday life. However, alcohol consumption is also associated with many social, economic and health harms, and it is a causal factor in over 200 disease and injury conditions (WHO, 2014). Recent years have seen a decrease in young adult harmful consumption rates in the UK<sup>1</sup>, although this does not appear to have manifested in a decline in alcohol-related hospital admissions for example, which continue to rise (HSCIC, 2017)<sup>2</sup>. As such, although consumption appears to be declining in the UK, alcohol-related harms, do not seem to have followed the same downward trend.

Although speculation, the continuing increase in alcohol-related hospital admissions may in part be explained by continuous heavy alcohol use of older generations (Chaplin, 2015), as the fall in alcohol consumption is largely driven by reductions in younger populations (HSCIC, 2017). However, not all admissions are consequent of continuous heavy drinking. Indeed, of the estimated 339,000 hospital

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<sup>1</sup> 57% of respondents on the 'Opinions and Lifestyle Survey: Adult drinking habits in Great Britain 2016' reported drinking in the previous week, 7% less than in 2006. Those reporting drinking > 6-8 units on their heaviest drinking day also fell by 4%. Such decrease was only evident in those aged 16-44.

<sup>2</sup> Alcohol-related hospital omission in 2015/2016 were 3% higher than those in 2014/2015 and 22% higher than 2005/2006 (Health and Social Care Information Centre, 2017).



admissions in England between 2015-2016, that were at least partially attributable to alcohol, cancer (over a quarter) and unintentional injuries (22%) were the top two diagnoses. The type of alcohol consumption behaviour relating to these outcomes are likely to differ somewhat. For example, those who consume large quantities of alcohol per week and those who drink on a regular and heavy basis appear at higher risk of a cancer diagnosis compared to light drinkers (Dickerman et al., 2016) and abstainers (Cao, Willett, Rimm, Stampfer, & Giovannucci, 2015). Unintentional injury however, is generally a consequence of state-dependent intoxication, where risk of injury increases with rising blood alcohol concentration (BAC) (Taylor et al., 2010). It is therefore expected to be more prevalent during heavy episodic drinking episodes (binge drinking) and may be linked to increased engagement in risky behaviours whilst intoxicated. As such, increases in hospital admissions may to some extent be explained by problematic consumption of older generations, whilst younger adults reduce their intake. However, such rises may also be attributable to risk-taking in intoxicated states.

Risky behaviour such as self-reported drink-driving is increasing (Department for Transport, 2014) and there has been no change in levels of reported violent incidents where the offender is believed to be intoxicated (Home Office, 2015). The difficulty in challenging such potentially harmful behaviours may, to a greater or lesser extent, lie in the acute effects of alcohol on inhibiting behaviour. In this regard, people's intention to drink safely before initiating drinking may not reflect consequent behaviour once intoxicated. In other words, although an individual may not intend to engage in risky behaviours, effects of alcohol could potentially override such intentions, as is suggested by the phrase '*it was the drink that made me do it*'. By examining the effects of alcohol on such behaviour, it may be possible to develop interventions that target more

successfully, individuals who are already intoxicated to reduce harmful behaviours in these settings.

It has long been suggested that alcohol-induced increases in risky behaviour are a result of the pharmacological effects of alcohol on cognition, including impairments in inhibition and enhanced impulsivity (c.f., Henges & Marcziński, 2012; Marcziński & Fillmore, 2003; Weafer, Milich, & Fillmore Mark, 2011). Alcohol-related injuries could therefore be asserted (at least in part) to be a product of cognitive deficits which may precipitate potentially harmful/risky behaviours such as drink-driving (e.g., Taylor et al., 2010), sexual risk-taking (e.g., Rehm, Shield, Joharchi, & Shuper, 2012; Scott-Sheldon, Carey, Cunningham, Johnson, & Carey, 2016), and aggressive acts (e.g., Ito, Miller, & Pollock, 1996). However, the relationship between alcohol and risky behaviour is complex, as risk-taking may act as both a determinant and a consequence of alcohol consumption (de Wit, 2008). With this in mind, it is necessary to consider not just risk-taking behaviour in intoxicated individuals, but also individual dispositions towards risks and how these may influence problematic alcohol use. For this reason, both possible pathways are subsequently discussed with regard to the age-old question *‘what came first? The chicken (whisky) or the egg (risky)?*

### **Risky to whisky**

Individual personality traits are an oft-cited risk-factor for a variety of alcohol consumption behaviours (Bozkurt et al., 2014), with impulsivity being one of the most commonly identified traits associated with alcohol use (Bø, Billieux, & Inge, 2016; Coskunpinar, Dir, & Cyders, 2013; Courtney et al., 2012). The concept of impulsivity is often used interchangeably with risk-taking behaviour, and although there does appear to be some overlap between the two (Meda et al., 2009), they are arguably not

synonymous constructs (Stamates & Lau-Barraco, 2017). An important distinction lies in the diverse nature of risk-taking, whereby one's decision to take a risk is not necessarily always impulsive. Conversely, engagement in risk can be the result of well thought-out and deliberated decision making (Leigh, 1999). However, the overlapping characteristics mapping onto both impulsiveness and risk-taking may offer some understanding of how impulsive personality traits, associated with engagement in risk behaviours, may influence alcohol consumption patterns.

Researchers suggest that there are two constructs which encompass impulsivity; behavioural disinhibition and impulsive decision making (B. Reynolds, Ortengren, Richards, & de Wit, 2006). Behavioural disinhibition refers to the inability to suppress a dominant response; when behaviour cannot be inhibited. For example, when measuring this construct, after being instructed to press a button when seeing alcohol-related cues, participants are required to suppress their response by not pressing the button when alcohol cues are presented. Those who are highly impulsive will be less likely to inhibit their behaviour in this scenario. Indeed, compared to controls, alcohol dependent samples show higher levels of disinhibition in such tasks (Lawrence, Luty, Bogdan, Sahakian, & Clark, 2009), thus implying an association between the construct of impulsivity and alcohol consumption. Moreover, path analysis conducted by Reniers, Murphy, Lin, Bartolomé, and Wood (2016) suggests either a direct or indirect association between behavioural inhibition and both risk perception and risk-taking. Here, findings indicate that those more able to inhibit their behaviour have increased perception of risk, and indirectly, lower risk taking compared to disinhibited individuals. Longitudinal studies further support the role of disinhibition on alcohol-related problems in late adolescence (Nigg et al., 2006; Tarter, Kirisci, Habeych, Reynolds, & Vanyukov, 2004). To this end, behavioural disinhibition (as a personality

trait associated with increased risk-taking) appears to be associated with alcohol consumption, and in some cases, is suggested to predict alcohol use (Courtney et al., 2012; Fernie et al., 2013; Fernie, Cole, Goudie, & Field, 2010).

The second construct, impulsive decision making, denotes a tendency to select immediate outcomes over delayed rewards with greater benefit; also known as delay discounting (Odum, 2011). For example, selecting an immediate £5 payoff, over a £10 reward given the following day. As with behavioural disinhibition, delay discounting has found to be associated with increased risk-taking (Courtney et al., 2012; Mishra & Lalumière, 2017), and seems to be elevated in heavy and harmful drinkers (Moody, Tegge, & Bickel, 2017). As such, both constructs of impulsivity are seemingly related to both risk-taking and alcohol use. However, the relationship between alcohol use and impulsivity on such tasks does not signify a causal pathway whereby impulsiveness on such tasks influences alcohol use. Alternatively, alcohol consumption may affect ones impulsive and risk-taking behaviour. Indeed, behavioural tasks used to measure risk-taking and impulsivity are state dependent (Lane, Rhoades, & Tcheremissine, 2003) and although these measures are suggested to predict alcohol use, performance on these tasks also appear to be affected by acute alcohol intoxication. Alternatively, self-report personality measures can capture apparent stable traits (Dick et al., 2010), and therefore may offer more understanding of impulsivity and risk-taking as a determinant (opposed to a consequence) of alcohol use (de Haan, Egberts, & Heerdink, 2015; Lane et al., 2003; Stamatēs & Lau-Barraco, 2017; Stanford et al., 2009).

The Barratt Impulsiveness Scale (BIS-11; Patton, Stanford, & Barratt, 1995) is one of the most widely used self-report measures of trait impulsivity (Stanford et al., 2009). Studies suggest levels of impulsivity (measured by the BIS-11) predict unique

variance in the quantity and frequency of alcohol consumption (Ferne et al., 2010; Henges & Marczinski, 2012; Stanford et al., 2009), indicating that impulsive traits influence alcoholic drinking. Moreover, higher scores on the more recently developed RT-18 (de Haan et al., 2011), a brief risk-taking questionnaire, are found to be associated with, and predict, the quantity and frequency of alcohol use, and harmful drinking behaviour (de Haan et al., 2015; Stamatēs & Lau-Barraco, 2017). Based on such previous findings, and on potentially state dependent effects on behavioural measures (Lane et al., 2003), using self-report measures may be more beneficial for measuring personality traits as potential determinants of alcohol consumption behaviours.

In sum, formative work suggests that higher levels of trait impulsivity predict increased alcohol consumption and more harmful drinking behaviour (Courtney et al., 2012; Ferne et al., 2010; Henges & Marczinski, 2012; Stamatēs & Lau-Barraco, 2017). Similarly, trait measures of risk-taking are found to be associated with alcohol use (de Haan et al., 2015; Stamatēs & Lau-Barraco, 2017). However, the majority of studies investigating risk-taking and alcohol consumption utilise behavioural tasks, which are limited in their predictive utility (Lane et al., 2003). To this end, as impulsivity does not capture all elements of risk-taking (for example, non-impulsive, deliberated risky choices), ongoing research investigating risk-taking as a determinant to alcohol use may help in identifying additional risk-factors aiding intervention efforts to reduce problematic alcohol use.

### **Whisky to risky**

Risk-taking behaviour can also be conceptualised as a consequence of intoxication. In this regard, effects of alcohol on risky behaviour are argued to be a

result of pharmacologically-induced cognitive deficits (Dry, Burns, Nettelbeck, Farquharson, & White, 2012), leading to engagement in risky behaviours (Giancola, Josephs, Parrott, & Duke, 2010). To test this assertion, experimental researchers typically administer acute doses of alcohol to healthy, non-dependent participants and subsequently examine their risk-taking behaviour compared to those in non-alcohol consumption conditions. Overall, research in this area appears to suggest that, relative to controls, alcohol consumption is associated with increased risk-taking behaviour (Bidwell et al., 2013; Lane, Cherek, Pietras, & Tcheremissine, 2004; Rose, Jones, Clarke, & Christiansen, 2014). Moreover, few studies have examined the dose-dependent effects of alcohol on risky behaviour, suggesting a linear relationship (Lane et al., 2003); risk-taking behaviour rises in line with increasing alcohol dose. Namely, gambles appear riskier with a BAC of .08% compared to .02, .04, and .05% (Bidwell et al., 2013; Lane et al., 2004), and participants are found to drive riskier at .08% BAC, than .05%. However, the findings in this area are inconsistent and other studies have found no difference in alcohol's effects between varying BAC (Berthelon & Gineyt, 2014; M. B. Reed, Clapp, Martell, & Hidalgo-Sotelo, 2013; Veldstra et al., 2012)<sup>3</sup>. Furthermore, some studies find negligible effects of intoxication overall on risk taking (Euser, Van Meel, Snelleman, & Franken, 2011; Peacock, Bruno, Martin, & Carr, 2013).

Such inconsistent findings may, to some extent, be attributable to the multi-faceted nature of risk-taking behaviour. Indeed, there are a variety of behaviours which have the possibility of resulting in negative consequences that appear to become more prevalent following alcohol consumption (Lane et al., 2004). These include risky

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<sup>3</sup> For more information regarding varying BAC/alcohol administration levels used to investigate alcohol effects on risk-taking see Chapter 6, Table 6.1.

choices when driving (Burian, Hensberry, & Liguori, 2003; Fillmore, Blackburn, & Harrison, 2008; Laude & Fillmore, 2016), gambling (Bidwell et al., 2013; Lyvers, Mathieson, & Edwards, 2015), and in sexual situations such as unprotected sex (Claxton, DeLuca, & van Dulmen, 2015; Lyvers, Cholakians, Puorro, & Sundram, 2011; Scott-Sheldon et al., 2016). In order to better understand the nature of the association between alcohol consumption and risk taking, it is therefore beneficial to consider separately the different domains of risk typically measured in research.

**Risky Driving.** Self-reported rates of driving while under the influence of alcohol (drink-driving) have been found to be increasing (Department for Transport, 2014), and statistics suggest that drink-driving contributed to 13% of all road mortalities in Great Britain in 2015 (Department for Transport, 2017). However, when tested experimentally, some studies have found alcohol consumption to be associated with reduced willingness to drive and increased perception of risk associated with driving (Amlung, Morris, & McCarthy, 2014). On the other hand, the risky choices made when driving (in a simulator) appear elevated when intoxicated (Burian et al., 2003; Burian, Liguori, & Robinson, 2002), suggesting more reckless driving following alcohol consumption. There is therefore an important distinction to be made between initiation of driving under the influence (DUI) and risk-taking whilst driving intoxicated. To this end, research by Amlung et al. (2014), alongside Burian and colleagues (2002; 2003) support the notion presented earlier; that individuals may not intend to engage in risky behaviour, but appear to frequently do so once intoxicated as alcohol effects supersede intentions.

Intention to drive after consuming alcohol is commonly measured in experimental studies via self-reported 'willingness to drive' (e.g., Amlung et al., 2014;

D. H. Morris, Treloar, Niculete, & McCarthy, 2014). However, as DUI is a criminal offence (when BrAC > .35mg/l), individuals may be less prepared to declare their willingness to drink-drive in these scenarios. Furthermore, those who engage in drink-driving may do so for potential gain or to avoid losses (e.g., to arrive home quickly or to save taxi costs), whereas previous work has merely queried their willingness in an abstract way and devoid of a specific scenario. To this end, reckless driving, such as people's likelihood to take risks whilst DUI or sober (e.g., run a red light to get to their destination quicker), may be a more reliable and ecologically valid measurement of risk-taking, relative to intention to DUI.

Reckless driving whilst intoxicated has largely been examined using driving simulators in a laboratory, following the consumption of alcohol or a placebo (e.g., Burian et al., 2002; E. L. R. Harrison & Fillmore, 2011; Van Dyke & Fillmore, 2014; Weafer & Fillmore, 2012a). Using such measures, consumption of alcohol has been found to increase risky choices at alcohol levels which are currently within legal driving limits (Burian et al., 2002). Driving simulators in this regard, offer a variety of outcome variables which may be classified as risky driving behaviour, including intervehicle time (distance between leading car and following car) and failure to stop at red lights. However, it is important to classify whether such outcome measures denote risk-taking rather than weakened driving performance owing to alcohol-induced motor and coordination impairments (c.f., Houa, Tomberg, & Noël, 2010; Marcziński, Fillmore, Henges, Ramsey, & Young, 2012). For this reason, participants are often given incentives to complete tasks in the fastest time possible. As such, participants may consider running a red light to be appealing, yet by doing so participants run the risk of a collision which would cost more time (Chein, Albert, O'Brien, Uckert, & Steinberg, 2011). Moreover, in previous studies (e.g., E. L. R. Harrison & Fillmore, 2011; Laude



& Fillmore, 2016; Van Dyke & Fillmore, 2015, 2017) a clear distinction is made between measurement of impaired driving skills (e.g., lane deviation) and risky or reckless driving (e.g., driving through a red light). This suggests that the contribution of alcohol towards drink-driving-related incidents is complex, as intoxication affects multiple associated behaviours (e.g., driving skill, motor coordination and risk-taking behaviour). It is therefore important to consider the type of behaviour measured in such driving tasks.

Where research has considered both performance and risky driving in the same study, driving skill appears to be impaired and risk-taking elevated following alcohol consumption, compared to a placebo beverage (Laude & Fillmore, 2015; Van Dyke & Fillmore, 2015). Further highlighting this distinction, other work (Berthelon & Gineyt, 2014; E. L. R. Harrison & Fillmore, 2011; Veldstra et al., 2012) has revealed an effect of alcohol only on driving skill, and not risky driving. For example, Harrison and Fillmore (2011) found impairments in driving precision (via lane positioning) after alcohol, compared to placebo, whereas failure to stop at red lights was not influenced by intoxication. Nevertheless, it has been questioned whether simulation is a valid representation of real-world risky driving (Jongen, Vuurman, Ramaekers, & Vermeeren, 2016). Driving simulators, it is argued, often lack motion experienced within real-life driving and therefore may limit the extent to which motions such as speed changes and immediate halts are experienced (Godley, Triggs, & Fildes, 2002). Research in this area would therefore benefit from further investigations, refining methods and systematically assessing specified driving-related behaviours (e.g. risky driving or driving skill).

**Gambling.** Unlike drink-driving, risk-taking in gambling appears most commonly associated with financial and social, as opposed to, physical harms (Clark, 2015). Nevertheless, gambling is a behaviour that is frequently linked with alcohol consumption (Ellery & Stewart, 2014), an occurrence which is seemingly exploited via the strategic placement of slot machines in public houses, and alcohol availability in casinos (Sagoe et al., 2017). It is perhaps for similar reasons that gambling tasks are one of the more widely used measures to assess alcohol-related risk-taking behaviour, as probabilities are easily manipulated and the level of risk quantitatively assessed. Moreover, by including monetary rewards and punishment akin to real life gambling, these tasks offer more ecological (realistic) assessment of risk (Burian et al., 2002).

Experimental research utilising the possibility of real gains and losses has largely been consistent in illustrating an increased likelihood of risk taking in those to whom the researchers have administered alcohol (relative to control/placebo, Burian et al., 2002; George, Rogers & Duka, 2005). However, in contrast, field studies suggest that increased BAC is associated with lower levels of risk-taking behaviour on gambling tasks (Lyvers et al., 2015; Proestakis et al., 2013). This raises questions regarding the extent to which laboratory experiments assess behaviours comparable to those occurring in real world contexts, and may point towards further influencing factors in naturalistic settings, which to date have been absent in lab-based contexts. Moreover, it has been noted that care should be taken with the complexity of gambling tasks as participants have previously revealed difficulty in understanding such tasks (Newall, 2017) while intoxicated (Dave, Eckel, Johnson, & Rojas, 2010; Proestakis et al., 2013). To this end, research investigating influence of alcohol on risky gambling behaviour provides some insight into the complexity of risk-taking, and alludes to the

importance of establishing measures both understandable, and akin to real-world behaviours to better represent intoxicated gambling ‘in the wild’.

**Sexual risk-taking:** The World Health Organisation has recently identified a causal relationship between harmful alcohol consumption and human immunodeficiency virus (HIV), and other sexually-transmitted diseases (STDs) (Baliunas, Rehm, Irving, & Shuper, 2010; WHO, 2014). It is suggested that the link between alcohol and the contraction of STDs is due (at least in part) to alcohol-related increases in risky decision making while in sexual situations, such as engaging in unprotected sexual intercourse (Rehm et al., 2012; Scott-Sheldon et al., 2016). Indeed, the link between intoxication and sexual risk-taking is well established in experimental research which measures intentions to engage in risky sexual situations (George et al., 2009; Lyvers et al., 2011; A. B. Morris & Albery, 2001; Rehm et al., 2012). However, increased likelihood to engage in unprotected sexual intercourse may also be influenced by the ‘*beer goggles*’ phenomenon (Lyvers, Cholakians, Puorro, & Sundram, 2009; Maynard, Skinner, Troy, Attwood, & Munafò, 2015; Pennebaker et al., 1979) (an increase in perceived attractiveness of others when intoxicated) than alcohol-induced risk-taking *per se*.

In sum, it is apparent that alcohol has been implicated as a relatively important influence on a variety of risky behaviours. However, the extent to which alcohol enhances or reduces risky behaviour is unclear. Moreover, while current intervention efforts which target individuals' drinking behaviour have appeared to be successful in reducing alcohol consumption (c.f., HSCIC, 2017), their success in reducing alcohol-induced risky behaviour is less apparent, with both drink-driving and alcohol-related

injury still rising (or unchanged) in numbers (Department for Transport, 2014; HSCIC, 2017). Many risky behaviours following alcohol consumption are characteristic of heavy episodic drinking, which is largely prevalent in young adults, in the night time economy (Measham & Brain, 2005). In these environments, alcohol is consumed in social contexts, where the influence of peers may play a contributing role to the observed increase in potentially harmful behaviours. With this in mind, variations between field and laboratory experimental findings (Lane et al., 2004; Lyvers et al., 2015; Proestakis et al., 2013; Richards, Zhang, Mitchell, & de Wit, 1999), may in part be due to contributing influences from drinking contexts (e.g., peers in the social environment).

## Social Influences

Historically, alcohol consumption has been an activity which is enjoyed socially with peers during many cultural and social celebrations (Gordon et al., 2012). Indeed, evidence suggests social drinking dating back to the Neolithic era, where alcohol seems to have been consumed in commemoration of the dead (Dietler, 2006). Advertisements have also historically portrayed consumption of their alcoholic products in social contexts (see Figure 1.1). What's more, alcohol consumption has been the purpose for popular social events from the Ancient Greek '*symposia*' (a drinking party; (Fairbairn & Sayette, 2014; McGovern, 2011) to modern day drinking festivals such as the German Oktoberfest and UK Gin Journeys.



*Figure 1.1* Alcohol advertisement from a UK newspaper in 1962, alluding to consumption as a social activity "...be sure you've Pony in the house when friends call round.". (Daily Express, 1962, July 25)

Importantly, the contexts in which alcohol is consumed and the cultural beliefs and expectations of drunkenness may, in turn, influence drinking behaviour and people's representation of intoxication. Alongside pharmacological-driven intoxicated behaviours such as impaired co-ordination (Houa et al., 2010) and anterograde amnesia (memory loss; Perry et al., 2006), depictions of intoxication such as aggression (Crane, Godleski, Przybyla, Schlauch, & Testa, 2016; Ito et al., 1996) and promiscuity (Rehm et al., 2012; Scott-Sheldon et al., 2016) may be dictated by one's cultural and social understanding of 'drunkenness'. MacAndrew and Edgerton (1969) argue the supremacy of these socially and culturally defined depictions of drunken comportment over "*toxically disinhibited brains operating in impulse-driven bodies*" (p. 165).

Furthermore, in addition to what people believe to represent intoxication, the social setting in which alcohol is consumed may further influence the alcohol-related behaviours displayed. Stemming from work on psychedelic drugs, Timothy Leary and later, Norman Zinberg coined this proposition as the influences of *set and setting*; drug effects being dependent on both the personality, mood and expectations of the individual (set), and the environment in which the drug is used/consumed (setting) (Hartogsohn, 2017; Zinberg, 1986). To this end, it is important to consider intoxicated behaviours not solely as a function of pharmacologically-driven drug-effects, but as a biopsychosocial phenomenon where behaviours are an outcome of intrapersonal factors, social and environmental settings, and the drug itself.

The impact of social and contextual influences on alcohol use and harms is further identified in the proposed conceptual model from the World Health Organisation (WHO, 2004), based on previous work (e.g., Blas & Kurup, 2010; Rehm et al., 2010) (see Figure 1.2). Pointing to the complexity of alcohol-related harms, the model suggests a multitude of factors contributing towards alcohol consumption, alcohol-

related health outcomes (to self and others) and socioeconomic consequences. Comparable to MacAndrew and Edgerton's *drunken compartment* hypothesis (1969), culture and context are placed as important contributors to alcohol consumption and related harms/consequences, and the impact of *set and setting* is identified by the distinction between societal and individual vulnerability factors within the model. What's more, the model clearly illustrates alcohol consumption behaviour as multi-faceted concerning not just the consumption of alcohol as a risk, but also the related harms which may, or may not be influenced by the drinking patterns.

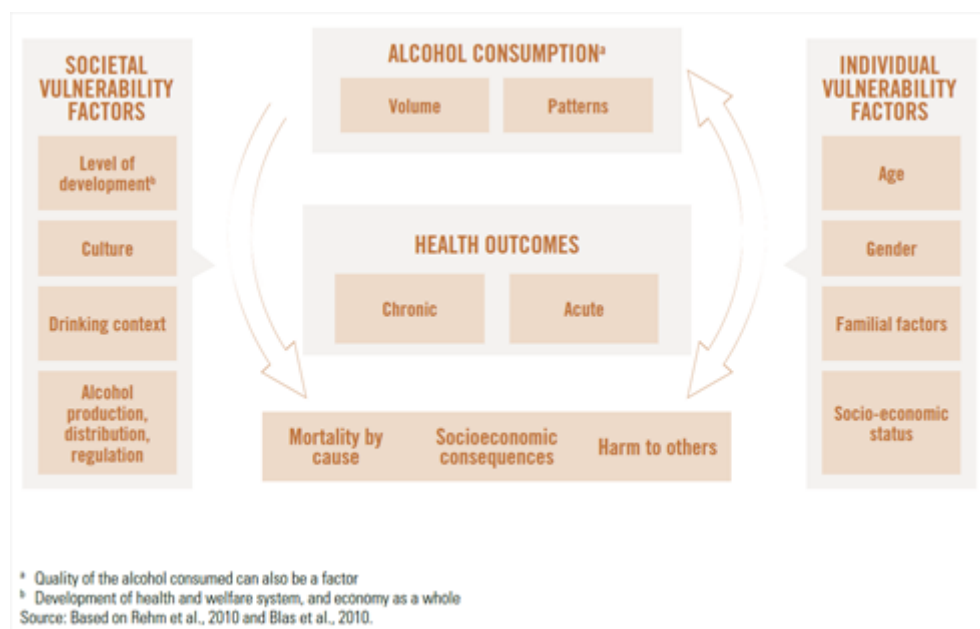


Figure 1.2 A conceptual model of the societal and individual factors contributing towards alcohol consumption and health outcomes (WHO, 2014).

Together, the social nature of drinking (Gordon et al., 2012), and the potential influences of these social settings and cultural beliefs (Fairbairn & Sayette, 2014; MacAndrew & Edgerton, 1969) highlight the importance in considering alcohol behaviours as not solely resulting from pharmacological and intrapersonal factors, but

also from social surroundings. To this end and to further understand the impact of alcohol on risk-taking behaviour, it would be prudent to acknowledge the social impact on both alcohol consumption, and risk-taking behaviour.

### **Social drinking**

In naturalistic studies, the presence of others have been found to increase an individual's alcohol consumption (Eisenberg, Golberstein, & Whitlock, 2014; Thombs, Wolcott, & Farkash, 1997), an effect which appears amplified as the number of peers in the group increases (Cullum, O'Grady, Armeli, & Tennen, 2012). Comparable findings have been indicated in experimental research, whereby the presence of unfamiliar peers appears to elevate drinking amounts (Kuendig & Kuntsche, 2012). In this regard, individuals may mimic the behaviour of others as suggested by Dallas et al., (2014), who found that individuals were more likely to choose an alcoholic over a soft drink when their peer (acting confederate) chooses an alcoholic drink first. Moreover, in addition to actual consumption, positive alcohol related beliefs appear to increase in the presence of others (Pedersen, LaBrie, & Lac, 2008). The influence of others on alcohol-related behaviours and continued consumption may, to an extent, be due to the elevated feelings of intoxication observed when in social groups opposed to being alone (Kirkpatrick & de Wit, 2013), which may subsequently enhance behaviours representative of intoxication (MacAndrew & Edgerton, 1969).

On the other hand, being part of a social group can have a positive impact on health-related behaviours (Crabtree, Haslam, Postmes, & Haslam, 2010; Jetten, Haslam, Haslan, Dingle, & Jones, 2014). For example, the presence of varied types of social support (friend, family, support groups) appear to aid in the alcohol recovery process by



promoting sustained abstinence within alcohol anonymous groups (for review see, Groh, Jason, & Keys, 2008). The process of social identity formation within recovery groups may help maintain cessation of the addictive substance, alluded to in the social identity model of cessation maintenance (SIMCM; Frings & Albery, 2015; Frings, Collins, Long, Pinto, & Albery, 2016, and the SIMOR model; Best et al., 2016). Here, it is suggested that when individuals are in recovery, moving from a social identity of ‘addict’ to one associated with recovery such as ‘recovering addicts’ or ‘alcohol abstainers’, enhances ones belief of cessation self-efficacy and control (Buckingham, Frings, & Albery, 2013). Furthermore, by identifying with others recovering (e.g., self-help group), individuals may feel more protected from ‘falling off the wagon’ as the group acts as a support (Frings et al., 2016).

### **Social influence on risk-taking**

In addition to their influence on alcohol consumption, peers may also impact engagement in risky behaviours, independent of the effects of intoxication. A large amount of research into the influence of groups on risky behaviour was inspired from formative work by Stoner (1961), who found that males made significantly riskier decisions when in groups, compared to the decisions made individually, for which he coined the ‘*risky shift*’ (Isenberg, 1986; Moscovici & Zavalloni, 1969; Wallach, Kogan, & Bem, 1962). More recent work has further implied increased risk-taking when in the presence of others compared to when alone (Blakemore & Mills, 2014; E. K. Reynolds, MacPherson, Schwartz, Fox, & Lejuez, 2013), with these effects being more particularly pronounced in adolescents and young adult populations (Gardner & Steinberg, 2005). The social influence exerted on risk-taking behaviour is illustrated also anecdotally by online trends such as Nominatime and The Lynx Challenge - where peers are challenged (and videoed) via online social networking to consume

dangerous levels of alcohol and carry out risky behaviours (NekNominate; Zonfrillo & Osterhoudt, 2014) or endure the pain of continued deodorant sprays on to the skin, producing cryogenic burns (The Lynx Challenge; Cubitt, Combellack, & Drew, 2014).

However, as with alcohol use, social factors have also been suggested to have a positive influence on decision-making and behaviour. Here, the notion is that ‘two heads are better than one’ (Charness & Sutter, 2014), as it is believed that groups of individuals will provide a greater variety of options, from which the most favourable course of action will be identified (Kerr & Tindale, 2004). Accordingly, in contrast to the notion of risky shift, research has found group influence to be dependent on the inclination of individuals members, whether they be more cautious or riskier (Moscovici & Zavalloni, 1969). Here, group decisions or attitudes are ‘polarised’, as the group choice will be exaggerated in the socially favoured direction of the individual group members. The type of risk presented may further influence group decisions when individual members are permitted to discuss the options. Discussion surrounding risky scenarios known to result in more cautious behaviour in ‘real life’ may subsequently influence the group to decide on a more risk-adverse option (Stoner, 1968). The social influences on risk-taking behaviour are seemingly complex, as it appears that both the characteristics of the group in question, and the type of risk taken (or not taken) contribute to the decisions made in social contexts. To this end, if considering the risk-taking behaviour of social drinking groups, it is important to consider the type of risks occurring within these populations (e.g., drink driving, antisocial behaviour, and drinking games) to help aid intervention efforts.

In sum, research to date has largely been separated into two well-established areas: first, research which examines the link between alcohol and risk-taking, and second, the influences of social context on drinking and risk-taking independently. However, there have been to this point, very few studies which have attempted to examine both the social and alcohol consumption effects on risk-taking behaviour, and there have been conflicting findings evident in such efforts (Abrams, Hothrow, Hulbert, & Frings, 2006; Hothrow, Randsley de Moura, Meleady, Abrams, & Swift, 2014; Sayette, Dimoff, Levine, Moreland, & Votruba-Drzal, 2012).

### **Social influences and alcohol effects on risky behaviour**

The majority of experimental research investigating the effects of alcohol on risk-taking behaviour has been carried out on individuals in isolated contexts, which are arguably far removed from the settings in which drinking generally takes place (c.f., Gordon et al., 2012; Heath, 2000; Hothrow et al., 2014). Furthermore, as discussed previously, social settings in themselves may influence both alcohol consumption behaviours (Fairbairn & Sayette, 2014; Kuendig & Kuntsche, 2012) and risk-taking (Blakemore & Robbins, 2012; E. K. Reynolds et al., 2013), which could, to a greater or lesser extent, be driving, or contributing to, the association between alcohol and risk-taking in real world scenarios. However, in this regard few studies have examined the interaction of social influences and alcohol consumption on risky behaviour experimentally, and those that do present varied findings.

Using alcohol administration techniques, Sayette, Kirchner, Moreland, Levine, and Travis (2004) investigated the effects of acute alcohol consumption on group decision-making regarding risk. In line with previous research conducted on individuals in isolation (c.f., George et al., 2005; Lane et al., 2004) findings illustrate an increase in

risky decisions following alcohol consumption, compared to a soft drink. However, when comparing decisions made by groups with those by isolated individuals in a later study (Sayette, Dimoff, et al., 2012), an alcohol-induced increase in risk-taking behaviour was only found in those who were tested in groups relative to intoxicated individuals making the decision in isolation. This suggests that the effect of alcohol on risk-taking behaviour may be dependent on social context, whereby alcohol consumption does not influence risky behaviour when alone.

In contrast, Abrams et al. (2006) found there was an alcohol-related increase in risk-taking behaviour in those who took part in isolation, whereas groups risk choice did not differ following alcohol or placebo. Contrariwise to Sayette, Dimoff, et al. (2012), this points to a possible protective effect of social context whereby usual alcohol-induced risk-taking is diminished when making decisions collectively as a group. The positive influence of groups in the regard is further supported by experimental field research by Hoptrow et al. (2014) who found risk-taking was reduced in groups as a function of intoxication (relative to individuals whose risk-taking increased). Outlining the diminutive research conclusions from examination of groups and alcohol effects on risky behaviour, has highlighted the inconsistencies in this field.

Further insights into the inconsistencies in this area of research may be gained by studying the procedural difference between studies. In Sayette, Dimoff, et al. (2012), all participants consumed their beverages within group contexts, before completing a risky decision either within their groups or alone. In contrast, participants in Abrams et al. (2006) remained in the same context (in isolation or in a group) throughout the study, and therefore some participants consumed their beverages in isolation. As such, it may be suggested that participants respond differently following social drinking (Sayette,

Dimoff, et al., 2012), compared to drinking in isolation (Abrams et al., 2006). A further consideration of previous studies regards their measurement of risk-taking as a collective decision (Abrams et al., 2006; Hothrow et al., 2014; Sayette, Dimoff, et al., 2012) as opposed to assessing an individual's risk-taking decision in the presence of others. Indeed, the concept of risk-taking is multi-faceted and risk-taking behaviour occurring in social settings is not always preceded by a group discussion and is often spontaneous (B. Reynolds, Ortengren, et al., 2006), therefore encompassing both impulsive actions and more thought-out analytical decisions. Furthermore, previous research has found decisions to differ in group contexts dependent of whether these are made with groups (collectively) or in groups (privately but in the presence of others) (Frings, Hothrow, Abrams, Hulbert, & Gutierrez, 2008). Here, collective group decisions were found to be less erroneous on vigilance tasks, thus supporting the notion that *'two heads are better than one'*. This highlights the necessity to distinguish between collective group decisions, and individual decisions within a group, particularly as, in many drinking scenarios, risk-taking behaviour is not preceded by group discussion. However, group influence on individual risk-taking has not yet been examined experimentally in intoxicated groups. The impact of social drinking on individual, as opposed to collective (group) risk-taking therefore remains unclear.

## **Methodological Considerations**

Much research investigating the relationship between alcohol and risk-taking behaviour is experimental and lab-based (Hopthrow et al., 2014). Lab-based experimental studies in this domain are beneficial for controlling the quantity of alcohol consumed, which is especially important when considering possible dose dependent effects on alcohol-induced behaviours (c.f. Lane et al., 2004). However, research conducted in field (natural drinking environments) produce contrasting findings to lab-based studies. For example, when tested in natural drinking contexts, intoxication levels (via BAC) are found to be negatively associated with risk-taking behaviour (Lyvers et al., 2015; Proestakis et al., 2013), whereas lab-based studies have often found elevated risk-taking following alcohol consumption (George et al., 2005; Rose et al., 2014) which, heightens with increasing alcohol dose (Lane et al., 2004). Such inconsistencies point to the potential effect of context on either risky behaviour and/or the effects of alcohol. As such, it is important to investigate this relationship across varied contexts in order to develop a wider understanding of alcohol, contextual and social influences on risky behaviour.

A further methodological issue in this area of research is the measurement of realistic risk-taking behaviour, within the limits of ethical considerations. There are a variety of measures used to examine risk-taking behaviour. Some of these methods are specific to the particular domains of risk-taking that are being studied (e.g., risky driving examined using driving simulators; Burian et al., 2002; 2003), while other methods aim to assess risk with more general measures (e.g., computerised non-specific tasks; Lejuez et al., 2002). Nevertheless, a difficult problem to overcome when measuring risk-taking behaviour in a controlled fashion is the ability to utilise a task with outcomes which participants will perceive as being genuinely negative, thus

making their behaviour (at least seem) risky (Dohmen et al., 2011). Tasks in which bonus participant money is gained and lost attempt to address this issue (e.g., Burian et al., 2002; 2003; Hothrow, Abrams, Frings, & Hulbert, 2007; Proestakis et al., 2013). However, gambling tasks may be difficult for some participants to understand and therefore it is necessary to keep these tasks simple (Dohmen et al., 2011).

Other popular methods to assess risk-taking behaviours are computerised tasks such as the balloon analogue risk-task (BART; Lejuez et al., 2002) and the Stoplight Task (SLT; Chein, Albert, O'Brien, Uckert, & Steinberg, 2011). The BART has been used to predict unique variance in risky behaviours (Lejuez et al., 2002), and alcohol consumption, even after controlling for impulsivity (Fernie et al., 2010). However, as with many computerised behavioural measures, practice effects present a potential issue as participants may become more skilled over repeated trials or lose interest (Rose et al., 2014). Furthermore, as the BART does not denote a realistic risk-taking scenario (blowing up a balloon to gain points), it is difficult to generalise the results of this task to real world risky behaviours.

The measurement of risk also becomes an issue when testing takes place in group contexts. So far, previous research (Abrams et al., 2006; Hothrow et al., 2014; Sayette et al., 2004; 2012) has examined a collective decision of risk from the group. If risk-taking is influenced by personality characteristics, these same characteristics may also influence individuals to voice their ideas or be more persuasive (c.f., Oreg & Sverdlik, 2013), which may guide a collective group decision accordingly. A collective, risky behaviour measured in such research may therefore be more truly reflective of the proclivities of one or two more extrovert or decisive individuals within the group, rather than representing a truly group decision. An alternative way of examining group

influence is by collecting individual measures of risk-taking in group contexts, thereby examining how being in a group influences the individual. Indeed, previous research (Frings et al., 2008) has found collective group decisions to differ from individual decisions made in group contexts. As such, it seems pertinent to examine further the effect of intoxication on individual risky decision making in group contexts.

Previous works examining collective decisions may also be limited as, in doing so, they have focused on calculated and deliberate risk-taking behaviour, thus disregarding more impulsive, unplanned risks. It is important to take into consideration that risk-taking behaviours in the real world may not always be preceded by discussion. In fact, impulsivity (which can be theorised to be a construct of risk-taking behaviour; Rose et al., 2014) is characterised by making unplanned and rapid choices or reactions (Potenza & de Wit, 2010). As such, it is important to note that studies on individual decision making in group contexts may differ from group decision making for a number of reasons and more research examining individual decisions in group contexts seem important. Indeed, to my knowledge, the role of alcohol and social context on individual risk (in group settings) has yet to be examined and thus remains unclear.

Overall, previous inconsistencies in the literature may be in part, explained by the varied procedures, methods and risk-taking measures utilised across studies. More specifically, the relationship between alcohol and risk-taking behaviours appear to differ dependent on the testing contexts (field studies; Lyvers et al., 2015; Proestakis et al., 2013, vs. lab-based research; Lane et al., 2004; Rose et al., 2014). It is therefore important to establish whether findings from lab-based work can be extrapolated to real-world settings and to better consider the role of context in this relationship. Moreover, to fully measure the role of alcohol on risk-taking, it is important to establish alcohol



effects across various risk domains, as opposed to generalising findings from one risk domain to another (e.g., generalising findings on risky gambling to risky driving). Moreover, many risk measurements fall short in representing real world risky behaviours and as such, research would benefit from measures more akin to real world risky behaviours in populations where alcohol-induced risk-taking may be more pronounced (e.g., students). Finally, the measurement of group influence has, to date, been based on collective group decisions. As such, little is known about alcohol and group effects on an individual's risk-taking behaviour. Utilising measurement which allows individual measures of risk would consequently be fruitful in delineating such effects.

## **Theoretical Perspectives**

In the main, theoretical perspectives posit that alcohol and risk-taking behaviour are driven by cognitive processes (Dry et al., 2012; Mocaiber et al., 2011). This body of work alludes to pharmacologically induced deficits in cognitive functioning leading to disinhibition (Leeman, Toll, Taylor, & Volpicelli, 2009) and increased attentional bias, or focal narrowing (Steele & Josephs, 1988; Steele & Josephs, 1990). However, as drinking generally occurs alongside peers (Gordon et al., 2012; Heath, 2000), it is important to consider the contributing social factors on alcohol-related behaviours. The following sections will therefore discuss how explanations of alcohol-induced cognitive deficits in inhibition and attention-allocation, may aid in our understanding of alcohol's effects on risk-taking. Moreover, these hypotheses will be considered in light of the social settings in which alcohol consumption generally occurs, with further discussion of the social factors which may influence the behaviours in question.

### **Disinhibition**

As identified previously, behavioural disinhibition is often labelled as a construct of impulsivity, although some argue that the two are not synonymous (Kocka & Gagnon, 2014). Impulsive, or disinhibited, individuals share a number of characteristics, whereby they appear to make quick decisions, carry out unplanned behaviours (Fernie et al., 2010; Weafer & Fillmore, 2012b) and have difficulty inhibiting prepotent responses, diminishing behavioural constraint (Giancola et al., 2010; Leeman et al., 2009). Assessing these characteristics, disinhibition is typically tested in a laboratory using behavioural tasks such as the go/no-go task (Marczinski & Fillmore, 2003), where reaction time and frequency of failed attempts to inhibit

behaviour (such as a button pressing) are measured. Accordingly, research using this behavioural task has found that alcohol consumption seems to be associated with a longer reaction time during trials requiring inhibition, and increases in inhibitory failures (false alarms) (Henges & Marczinski, 2012; Weafer et al., 2011). However, akin to impulsivity, disinhibition is also indicated to be both a determinant, and consequence, of alcohol consumption (de Wit, 2008; Leeman et al., 2009).

The notion of alcohol consumption being a determinant of disinhibition has been supported by some longitudinal research, suggesting those less able to inhibit behaviour will develop more alcohol use issues in later years (Nigg et al., 2006; Tarter et al., 2004). Often viewed as a trait ability that is independent of contextual influences (Gladstone & Parker, 2005), it could be assumed that inhibitory control cannot be affected by situational or external cues (such as intoxication or peers). Yet, both chronic and acute alcohol consumption have been found to alter the ability to inhibit behaviour (Jones, Christiansen, Nederkoorn, Houben, & Field, 2013), suggesting fluctuations (opposed to stability) in disinhibition. In support of chronic alcohol consumption effects on risky behaviour, persistent heavy alcohol use appears to be associated with changes in brain structures linked to behavioural control, such as frontal lobe functioning alternations and neurodegeneration (Crews & Boettiger, 2009). The latter (acute consumption) is largely assessed using alcohol administration procedures which often find that intoxicated individuals (opposed to control) demonstrate impaired behaviour inhibition (Adams, Ataya, Attwood, & Munafò, 2013; Weafer & Fillmore, 2012b).

Although these findings imply possible fluctuations in disinhibition, the inability to inhibit behaviour may still serve as *both* a determinant and consequence of alcohol

consumption (as opposed to one or the other) (c.f., Jones et al., 2013). Supporting this supposition, the concept of ego depletion builds upon the assumption that inhibitory control is sourced from a finite reserve which, if overly-exerted, is said to result in diminished self-control resources (Baumeister, Muraven, & Tice, 2000; Muraven & Baumeister, 2000)<sup>4</sup>. In other words, it's suggested that if self-control is already being exerted (e.g., in drinking settings; Muraven, Collins, & Neinhuis, 2002), less resources may be available to inhibit other behaviours (e.g., risk-taking; Fischer, Kastenmüller, & Asal, 2012; Unger & Stahlberg, 2011, or continued drinking; Christiansen, Cole, & Field, 2012). Therefore, the inability to suppress temptation (via disinhibition/impulsivity trait or overly-exerted self-control elsewhere) may result in alcohol consumption (disinhibition as a determinant). Such self-control resources utilised when intoxicated may reduce the ability to inhibit other behaviours (disinhibition as a consequence).

Ego depletion not only appears to elucidate the association between alcohol (consumption or cues) and disinhibited behaviours, but also the impact of other contextual influences which may require an element of control. With reference to social contexts, due to the saliency of one's social identity, individuals may be more likely to match their behaviour and attitudes to their peers (Borsari & Carey, 2001; Monk & Heim, 2014b; Tajfel & Turner, 1986), requiring an element of self-control. Thus, disinhibition and ego depletion together, may aid in explaining both alcohol and contextual influences on risky, disinhibited behaviours.

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<sup>4</sup> It should be noted here that the ego depletion hypothesis has recently been subject to several criticisms and failed replications, discussion of which is beyond the scope of this thesis (for further information regarding debate see Baumeister & Vohs, 2016; Drummond & Philipp, 2017; Hagger et al., 2016; Hagger & Chatzisarantis, 2016).

The disinhibition hypothesis appears useful in understanding alcohol's effects on impulsive risky behaviour, but generally lacks explanation of individual variability in alcohol effects (Quinn & Fromme, 2016). Furthermore, the resulting behaviours understood through the disinhibition hypothesis are of an impulsive nature, and therefore only capture a specified element of risk-taking. In this respect, dual process models propose risk-taking decisions to be consequent of either *hot* affective states: decisions made impulsively and based on affective state, or *cold* analytical processes: decision-making which is thought-out, deliberated and calculated in terms of probabilities and expected value (Heinz, Beck, Meyer-Lindenberg, Sterzer, & Heinz, 2011; van Gelder, de Vries, & van der Pligt, 2009). Highlighting this distinction, intoxicated groups who are required to engage in discussion (*cold* processes) surrounding risky choice dilemmas, appear to select less risky options than sober groups (Hopthrow et al., 2014). However, when these decisions are made individually without discussion (possibility of *hot* processes), risk-taking is seen to increase as a function of intoxication, which may, to some extent, allude to an intoxication effect on only *hot* decision-making processes. These dual process models highlight the importance of attending to both contextual (group versus individual) variations and state differences (e.g., mood and intoxication), when investigating risk-taking.

In sum, the disinhibition hypothesis and ego depletion explanations appear useful in understanding alcohol's effects on impulsive risky behaviour, but generally lack explanation of individual variability in alcohol effects (Quinn & Fromme, 2016). Moreover, little consideration is given to how social contexts specifically, may further enhance or reduce the effects of intoxication (c.f. Kirkpatrick & De Wit, 2013). On the other hand, hypotheses from attention allocation models (the alcohol myopia model) may offer a more holistic understanding, by incorporating pharmacological, contextual

and intrapersonal factors in unpicking the influence of groups and alcohol on risk-taking.

### **Alcohol myopia model**

The alcohol myopia model (AMM; Steele & Josephs, 1990) incorporates both cognitive and social factors in alcohol-induced risk-taking, but is predominantly a theory embedded in cognitive psychology. As one of the dominating explanations of intoxication effects on risk-taking, the model posits that alcohol induces a narrowing of attention, with focus being drawn to the most salient and readily processed cues (Steele & Josephs, 1990). Consequently, there is a reduction in peripheral attention which hinders systematic processing and impedes full evaluation of behavioural consequences. AMM shares some characteristics of the disinhibition hypothesis whereby intoxication impedes full systematic evaluation of consequences and therefore individuals may behave more impulsively (Giancola et al., 2010). However, one crucial difference between these two explanations concerns the extent to which environmental cues are considered. While theories of disinhibition posit alcohol-induced risk-taking regardless of environmental cues (MacDonald, Fong, Zanna, & Martineau, 2000), AMM suggests the impact of alcohol on subsequent behaviour is dependent on the saliency of surrounding cues.

According to Steel and Josephs (1990), alcohol suppresses cues which would typically induce inhibitory control. As such, in situations where there is response conflict – where there are both provoking and inhibitory cues – intoxication means individuals are more likely to act on the provoking cues as opposed to the inhibitory cues, as acting on impulse is less demanding than acting to inhibit a response (Monahan

& Lannutti, 2000; Steele & Southwick, 1985). An illuminating example of this is provided by Monahan and Lannutti (2000): A spurned ex-lover encounters their former lover (for whom they still have feelings) while in a bar. Upon seeing the ex-lover (the provoking cue) they may make an impulsive decision to approach in an attempt to rekindle the romance, while at the same time there are potential inhibiting cues (the desire to avoid public embarrassment, for example). Seeing an ex-lover therefore creates a response conflict between impulsive approach and restraint/avoidance. According to AMM, when sober, the person may choose to restrain their impulse in light of the inhibitory cues, whereas when intoxicated the inhibitory cues are damped, making approach more likely (*ibid*). AMM can therefore offer important insights as to how alcohol consumption may render one more likely to take impulsive and potentially risky behaviours.

A large body of literature has examined the value of AMM on explaining alcohol-related sexual risk-taking. To this end, the research findings have largely supported the notion that there is a focal narrowing towards environmental cues which influences sexual decisions (Lyvers et al., 2009, 2011; A. B. Morris & Albery, 2001; Prause, Staley, & Finn, 2011). The influence of attentional myopia to environmental cues has further been evidenced in experimental field work (Flowe, Stewart, Sleath, & Palmer, 2011). Here, males BAC in public houses was positively associated with hypothetical engagement in sexual aggression, but only when women were wearing revealing clothing (a somewhat harmful, stereotypical view of women's sexual availability).

Although AMM may aid in explaining the effects of alcohol on *increased* risk-taking behaviour, the model further affords potential insight into how focal narrowing may in some instances, *reduce* the likelihood of engaging in potentially harmful behaviours (Giancola et al., 2010; Mocaiber et al., 2011; Steele & Josephs, 1988). For example, when MacDonald et al. (2000) primed participants with inhibiting cues regarding sexual risk-taking (e.g., “Rebecca tells Mike that she is on the pill, but... he cannot be certain of this”; p. 614), intoxicated individuals were less likely than sober participants to report an intention to engage hypothetically, in unprotected sex. Here, increased attention appears to be allocated to the inhibiting cue when intoxicated, thus reducing the likelihood to engage in risky behaviour. Gambling research may also offer some support in this regard. Here, risk-taking behaviour following 0.6 g/kg of alcohol appears to be reduced when losses are large as attention is directed towards potential losses, even when the likelihood of winning is high (George et al., 2005), also suggesting that in some instances, alcohol-induced focal narrowing may reduce risky choice.

AMM further aids a possible understanding of how *hot* affective states (Heinz et al., 2011; van Gelder et al., 2009) may drive the effects of alcohol on risky-behaviours. Here, intoxication may narrow one’s attention to their emotional state, driving decisions in this regard. Alternatively, attention may be diverted towards other prominent cues, and reduce focus on mood state (Giancola et al., 2010, Mocaiber et al., 2011; Steele & Josephs, 1988; 1990). Evidencing this suggestion, Steele and Josephs (1988) found that intoxicated participants display less anxiety towards an impending verbal presentation when they were required to judge art slides in the interim (diverting attention from emotion), compared to sober participants. However, when no distracting interim task was given, those who had consumed alcohol demonstrated higher anxiety than their



sober counterparts, suggesting that alcohol had narrowed attention to this negative emotion. As such, it may be that, depending on one's environmental cues, alcohol can exert either a positive and negative impact on affective states, in addition to risk-taking, which may be partially dependent on mood and environment (George et al., 2005; Giancola et al., 2010; Mocaiber et al., 2011; Steele & Josephs, 1988; Steele & Josephs, 1990).

AMM may also afford some insight into group influences on alcohol-induced behaviour. As attention is narrowed to salient environmental cues, in social drinking settings, alcohol-induced focal narrowing on one's peers may drive behaviour that is intended to ensure alignment with the perceived norm or the group. Increased attention towards group benefits in social drinking scenarios has previously been observed in the investigation of group co-operation on the prison dilemma game.<sup>5</sup> (Hopthrow, Abrams, Frings, & Hulbert, 2007). Specifically, groups who consumed alcohol (compared to control) appear less able to consider long-term consequences as focus is directed towards immediate group benefits. Therefore, intoxicated groups will generally choose to betray the other group in return of immediate reward for their group.

In sum, the efficacy of AMM in understanding the influence of alcohol on risk-taking behaviour supports a more encompassing explanation opposed to considering only the disinhibition hypotheses. Namely, pharmacological, intrapersonal and environmental factors are considered within the model, arguably enabling a more

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<sup>5</sup> The prisoner dilemma assesses competitiveness and cooperation. Players are given the option to betray or cooperate with the competing player. Here, if one betrays and the other cooperates, the betrayer will receive a big win and co-operator a large loss. If both betray they both suffer a loss and if both cooperate then they both gain. (Hopthrow, Abrams, Frings & Hulbert, 2007).

nuanced understanding of the differing effects of intoxication on behaviour in varying settings (MacDonald et al., 2000; Prause et al., 2011).

### **Group Polarisation and the Risky Shift**

The risky shift and group polarisation hypothesis offer some understanding into the influence of groups on risk-taking behaviour, and thus focus more around social influences opposed to alcohol effects. However, such explanations are useful in unpicking the influence of social contexts usually present when alcohol is consumed and may aid in understanding previous inconsistencies in lab-based and field research investigating alcohol and risk-taking (e.g., Lane et al., 2004; Proestakis et al., 2013).

Formative work by Stoner (1961) indicated that groups were significantly more likely to take higher risks than individuals, for which he coined '*the risky shift*' (Moscovici & Zavalloni, 1969; Myers & Lamm, 1976; Stoner, 1968). Further, this effect is suggested to be pronounced in larger groups (Teger & Pruitt, 1967), that being, the larger the group, the riskier they become. In this case, it may be suggested that risk-taking behaviour in social drinking contexts is partly influenced by the number of peers present. However, stemming from Stoner's work, the group polarisation hypothesis (Moscovici & Zavalloni, 1969; Myers & Lamm, 1976), theories that groups enhance the average inclination of the individual group members, opposed to solely causing them to be riskier (Moscovi & Zavallani, 1969; Myers & Lamm, 1976). Here, Moscovici and Zavallani (1969) found that group decisions produced a polarisation of responses. In other words, the group decision was exaggerated in the socially favoured direction of the group members. For example, if in a group of high risk takers, risky choice will be heightened further than that of the average group member. However, when in a group of

low risk-takers, individuals will act more cautiously opposed to if they were alone. As such, the influence of groups on risky behaviour is dependent on the characteristics of the group members, highlighting the complexity of group influence.

In addition to polarisation effects following group interaction, the mere exposure to others' judgements (without interacting with others) has also been found to influence individual's risk-taking in a polarised fashion (Myers, 1978). Supporting this notion, Valacich et al. (2009) found group polarisation effects in computer mediated communication, comparable to face to face groups suggesting that the virtual presence of others has an equally powerful impact on decision making as face to face groups and therefore may aid in explaining extreme behaviours seen on social networking sites (NekNominate and the lynx challenge). The influence of others presence (opposed to interaction) works on the contention of normative influence, which refers to the influence in which others have on an individual's behaviour and attitudes, without necessarily communicating with them. That being, individuals are influenced by what they perceive to be the norm, in order to align and be accepted by others (Deutsch & Gerard, 1955). The role of social norms is discussed in more detail in the subsequent section 'Perceived Social Norms'

Considering the contribution of group polarisation on the combined influence of groups and intoxication on risky behaviour, it may be suggested that due to alcohol's proposed increase on risk-taking (c.f., Lane et al., 2004), groups of intoxicated individuals will increase their risk-taking behaviour beyond that of the group average (which due to alcohol's effects would suggest a high risk-taking average). On the other hand, sober groups would not be as consistent, as the effect of the group will depend on

the risk personalities of the comprising group members. However, to date this has not been observed (Abrams et al., 2006; Hothrow et al., 2014; Sayette, Dimoff et al, 2012; Sayette, Kirchner et al., 2004). The group polarisation hypothesis offers little understanding of the additional influence of alcohol, but does offer some thought for the role of groups in risky behaviour. Further, this perspective highlights the importance of considering individual characteristics when investigating social groups. As mentioned previously, polarisation effects in some instances, are posed to be based on normative influence. Considering the role of such social norms in relation to alcohol, may provide a more holistic insight of the role of both groups and alcohol on risky behaviour.

### **Perceived social norms**

The way in which social groups influence individual behaviour may be understood through the importance of constructing and maintaining a social identity (Tajfel, 1979; Tajfel & Turner, 1986). In this regard, in order to enhance self-esteem through identification with a group, individuals may alter their beliefs and behaviours to meet their social surroundings (Festinger, 1954). In other words, people's behaviour can be driven by the perceived social norm - the perceived attitudes, beliefs and behaviours of other individuals or specific groups. The social norm approach to peer influence argues that an individual's behaviour and beliefs are often influenced by misperceptions about the commonality or typicality of those behaviours/beliefs in one's peers (Berkowitz, 2004). Subsequently, behaviours/beliefs are adjusted and aligned with ones' peer groups – in other words changes are made to fit the (mis) perceived norm.

It is said that there are two distinct forms of normative beliefs: The first, descriptive norms, refer to the perception of how peers *normally* behave. For example,

the belief that peers go out drinking twice a week. The second, injunctive norms, refer to the perceived acceptability of or social approval for specific behaviours. For example, “*my friends think it’s fine to go out drinking more than once a week*” (Rimal & Real, 2003). Individuals appear to generally overestimate the quantity and frequency of their peers’ drinking behaviour (Borsari & Carey, 2001; Carcioppolo & Jensen, 2012; Halim, Hasking, & Allen, 2012), as well as peer approval of drinking and risk-taking (Iwamoto, Cheng, Lee, Takamatsu, & Gordon, 2011; Kenney, LaBrie, & Lac, 2013), which in turn influences behaviour<sup>6</sup>. Individual observations about their peers’ behaviour once intoxicated, and perceived peer approval of alcohol-induced risk-taking, would therefore seem a worthy consideration in the alcohol and risk-taking literature.

The power of (mis) perceived norms to influence risky behaviour has potential implications for intervention efforts (Berkowitz, 2004). To this end, normative feedback interventions have attempted to reduce drinking behaviours largely in college/university settings by providing students with correct information regarding normative drinking behaviours (Berger & Rand, 2008; Carey, Scott-Sheldon, Carey, & DeMartini, 2007; Dotson, Dunn, & Bowers, 2015). Findings indicate that changing an individual’s perception of their group’s social norms will subsequently change their behaviour (Berger & Rand, 2008), and manipulating perceived proto-typicality towards the ingroup (how alike an individual is to their social groups ideals/characteristics) can decrease conformity to group norms (Goode, Balzarini & Smith, 2014). Such successful outcomes of normative feedback interventions are promising. With the aim of reducing potentially harmful risky behaviours in drinking contexts, is it therefore important to

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<sup>6</sup> It is important to note that recent work has discussed the role of social drinking norms as potentially a methodological artefact due to largely used questionnaires open to desirable responding and extreme perceptions (c.f., Melson, Monk, & Heim, 2016; Melson, Davies, & Martinus, 2011)

increase our understanding of the injunctive and normative beliefs associated with alcohol-related risk-taking.

A systematic review of the alcohol norms literature (Monk & Heim, 2014b) highlighted the importance in considering contextual influences when investigating the impact of alcohol-related norms on individual behaviour. Specifically, it is postulated that being in certain contexts (e.g., being in a bar and/or with friends) may activate perceived norms that are specific to that environment (e.g. risky behaviours may be viewed as more appropriate when amongst a group of peers). This may in turn drive the adoption of risky behaviour to meet this environment-specific norm. This is illustrated by Lo Monaco, Piermattéo, Guimelli, and Ernst-Vintila, (2011) who found that alcohol is considered 'normal' when it occurs in social contexts, but not when it takes place in solitary isolation. Findings point to the potential importance of environmental factors when assessing normative drinking beliefs and practices. As such, testing of alcohol-related risk behaviours would likely benefit from taking place in social contexts where risky behaviours generally occur.

## Overview of Thesis

To date, there has been little research examining the combination of both social context and alcohol consumption on risk-taking behaviour. Furthermore, the existing literature (Abrams et al., 2006; Hothrow et al., 2014; Sayette, Dimoff, et al., 2012) provides inconsistent findings with regards to the relative influence of intoxication and group contexts on risky choices, therefore arguably raising more questions than answers (Sayette, Dimoff, et al., 2012). Consequently, this thesis makes an original contribution to the literature by expanding the present understanding of how and why groups and alcohol consumption influence risk-taking behaviour.

Theoretically, the thesis examines both the predictive utility of risk-taking and impulsivity on alcohol consumption behaviours, and the impact of alcohol administration on risk-taking behaviour. Moreover, the experimental studies summarised in Chapters 3, 4, and 5, aim to further our understanding of both the independent and combined impact of social influence and intoxication on individual risk-taking behaviour. The thesis further aims to explore the utility of perceived injunctive norms in predicting risky behaviour across various social contexts.

Providing an original methodological contribution to research in this area, the PhD adopts a multi-methodological approach to examining risk taking. This includes survey data, alcohol administration research and an experimental field study. Moreover, a variety of risk-taking tasks have been utilised to explore domain-specific risk-taking measures (risky driving, lottery task, and physical risk-taking), in addition to more general tasks. Additionally, a meta-analysis is incorporated to contribute an empirical investigation of the previous alcohol administration research examining alcohol and

risk-taking behaviour, as well as the impact of social groups. Within this specific research area, risk-taking behaviour has until now been measured largely as a planned and calculated decision made collectively as a group (c.f. Abrams et al. 2006; Hothrow et al., 2014; Sayette, Dimoff et al., 2012; Sayette et al., 2004). Moving beyond this to explore alternative forms of risk-taking behaviour, the PhD therefore takes a novel approach of examining the influence of group contexts on individual risk-taking behaviour. Figure 1.3 provides a diagrammatic representation of the structure of the thesis, whilst the sections below offer an overview of the following chapters (Chapters 2 to 6 are presented as research papers).

Chapter 2 utilises a survey design to investigate the utility of impulsivity and risk-taking personality measures, in predicting a variety of alcohol consumption behaviours. The purpose of this first study chapter is to gain an initial understanding of how trait measures of risk-taking and impulsivity may be associated with alcohol consumption.

Chapters 3 and 4 follow with empirical investigations concerning risk-taking as a consequence to alcohol use. Here, Chapter 3 seeks to examine whether 0.5-6g/kg of alcohol influences risk-taking behaviour on two computerised risk-taking tasks, measuring both general (balloon analogue risk task; Lejuez et al., 2002), and domain-specific (risky driving on the stoplight task; Chein et al., 2011) risk-taking. Additionally, these effects are investigated in both isolated and group contexts. To further enhance the natural drinking environment, group testing takes place in natural friendship groups.



Chapter 4 builds systematically on this investigation by incorporating an increased dose of 0.8g/kg of alcohol to examine intoxication effects that are more representative of the quantity of alcohol consumed during binge drinking episodes. Additionally, a novel, physical measure of risk-taking was developed (*'The Shuffleboard Game'*) and validated against self-reported impulsivity and risk-taking. The Shuffleboard Game was utilised to mimic risky behaviours more akin with real world drinking games (Zamboanga et al., 2014), with the aim of increasing external validity of this risk-taking measure. The purpose of these two studies (Chapters 3 and 4) is to examine both the independent and combined effects of alcohol and group context on individual risk-taking behaviours. Moreover, Chapter 4 explores systematically the influence of alcohol on affective state, and effects of mood on risky behaviour.

Chapter 5 investigates the association between intoxication and risk-taking behaviour in real world drinking and non-drinking social environments, respectively. Risk-taking is investigated in these contexts using a short lottery task. Due to the naturally occurring social groups within these contexts, a solitary context condition was not investigated. The effects of group size and perceived injunctive norms on risk taking were investigated, across both contexts. Chapter 5 aimed to complement laboratory-based research presented in the previous chapters by examining context and intoxication effects on risk-taking in real-world settings.

The penultimate chapter (Chapter 6), presents a meta-analysis of the existing experimental literature which incorporates alcohol administration techniques to investigate alcohol's effects on risk-taking behaviour (including Chapter 3 and 4).

Further, the meta-analysis provides some insight into the potential contribution of social influences in this regard. Future research directions are also discussed.

The final chapter (Chapter 7) begins by summarising the previous chapters to present an overview of the thesis aims and findings in relation to the existing literature to make explicit the overall contribution this thesis makes. Overall limitations of the thesis and future directions are addressed, and potential research and intervention implications are also highlighted.

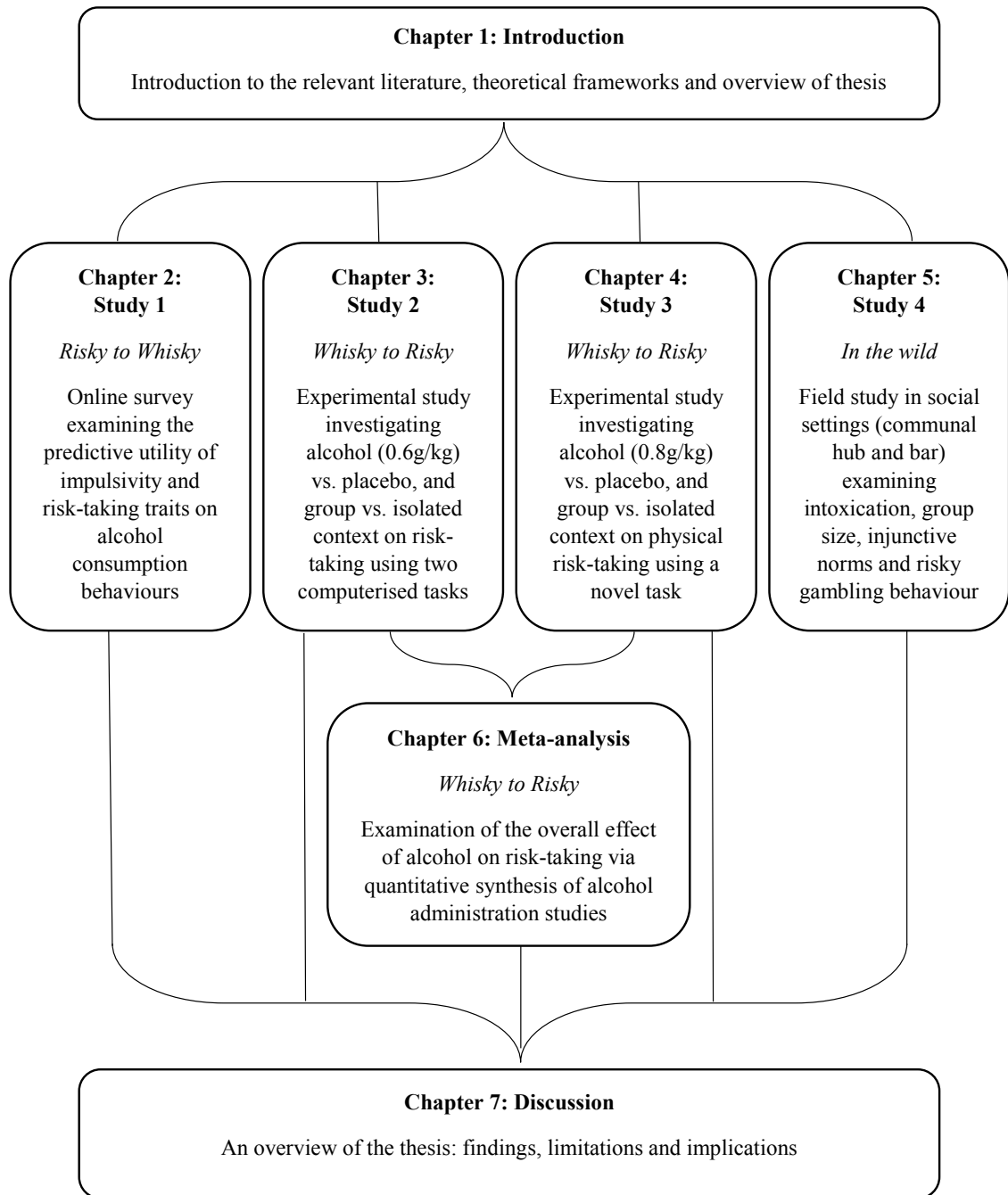


Figure 1.3 A diagrammatic representation of the thesis structure and chapter overview.

## Overview of Data Analysis

All empirical studies were subject to preliminary analysis, including screening for missing data and potential outliers, and assumption checks relevant to the proposed inferential analyses. Initially, Little's missing completely at random (MCAR) tests (Little, 1988) were conducted to ascertain whether missing values were missing at random, and therefore not dependent on other values in the data. If empty cells were confirmed to be missing at random, estimation maximisation was subsequently performed to adjust and insert values into empty cells (missing data) using information from the data set (c.f., Tabachnick & Fidell, 2013). Second, outliers were assessed via stem and leaf plots, and further confirmed by converting values into  $z$  scores to identify any scores above three standard deviations away from the mean. Any values above this were winsorized by calculating the mean, plus three standard deviations (in the relevant direction) and adjusting the outlier to this value, plus one (A. Field, 2009). For multiple regression Mahalanobis and Cooks Distance checks were used to identify any outliers.

Assumptions checks were also carried out prior to inferential analysis, which differed based on the intended analyses for the data. For example, Study 1 intended to use multiple regression and therefore assumption checks were conducted for multicollinearity (via the Variance Inflation Factor), homoscedasticity (via plots) and autocorrelation (Durbin-Watson test; Durbin & Watson, 1951). Other assumption checks to ensure homogeneity of variance were conducted across all studies (type of test varied with inferential analyses) (c.f., Tabachnick & Fidell, 2013). Finally, Bonferroni-adjusted  $p$ -values (.017 - .025) were used in Study 1 and 3 to reduce the likelihood of a Type 1 error. Detail of descriptive and inferential statistics used are reported for each study in their corresponding Results section.

## Chapter 2 Study 1

### Abstract

**Background:** Many studies have identified the predictive utility of impulsive traits on alcohol consumption, whereas risk-taking is often viewed as a consequence of intoxication. The diminutive research investigating risk-taking as a determinant of alcohol use, may be in part, due to its commonality with impulsivity, although many argue they are distinct constructs. The study therefore aimed to examine the extent to which impulsivity and risk-taking independently, and combined, predict alcohol use, whilst addressing associations between both constructs. **Method:** A total of 259 participants (190 females) completed an online survey. Questionnaires included (i) Barratt's Impulsiveness Scale (BIS-11) measuring attentional, motor, and non-planning impulsiveness, (ii) RT-18, identifying risk-taking, risk assessment and risk behaviour, and (iii) the alcohol use disorder identification test (AUDIT) capturing hazardous and harmful alcohol use, and dependence symptoms. **Results:** Regression analysis found that impulsivity and risk-taking accounted for between 8-11% variance independently, and 11-17% combined, in hazardous and harmful alcohol use, and dependence symptoms. However, the inclusion of impulsivity or risk-taking at the end of the regression model contributed only between 2-4% additional variance. Finally, subscales of impulsiveness and risk-taking significantly predicted different elements of alcohol consumption behaviour. **Conclusion:** Although there appears to be some overlap between constructs of impulsiveness and risk-taking, findings also support viewing these as non-synonymous, multi-faceted constructs. The study further identifies impulsivity and risk-taking as potential risk-factors for hazardous and harmful alcohol use, and dependence symptoms. Consideration of these constructs as multi-faceted may aid intervention efforts aimed at reducing various alcohol behaviours.

## Introduction

Heightened impulsivity and risk-taking behaviour have repeatedly been implicated in problematic alcohol consumption (Courtney et al., 2012; Fernie et al., 2010; Lane et al., 2004; Stephan et al., 2017). However, their association with alcohol use is complex, as heightened impulsivity and risk-taking are suggested to be predictors of excessive alcohol use, as well as the consequence of acute intoxication (de Wit, 2008). Much support has been found for the notion that impulsivity drives problematic alcohol use (Curcio & George, 2011; Hyucksun, Grace, & Jeon, 2012; LaBrie, Kenney, Napper, & Miller, 2014; Mackillop et al., 2011), though less research has addressed the role of risk-taking in predicting alcohol-related issues (de Haan et al., 2015; Stamatēs & Lau-Barraco, 2017). The lack of research surrounding risk-taking as a determinant of alcohol use may be partly explained by researchers interchangeable use of impulsivity and risk-taking as synonymous constructs, whereas many argue that they are distinct from one another (Fernie et al., 2010; Stamatēs & Lau-Barraco, 2017). To illuminate the relative and combined contributions of impulsivity and risk-taking in problematic alcohol use, there is therefore a need to more carefully consider the complex nature of such traits, and overlapping and distinct characteristics which influence alcohol consumption. Identification of such risk factors may benefit current intervention effort aimed to reduce harmful alcohol use.

Impulsivity is multi-faceted, and while there is no one agreed upon definition (Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001), many suggest that it is made up of two constructs: behavioural disinhibition and impulsive decision making (Courtney et al., 2012; Fernie et al., 2010; B. Reynolds, Ortengren, et al., 2006). Behavioural disinhibition is the inability to suppress prepotent responses (Fernie et al.,

2010), whereas, impulsive decision making is a type of risk-taking where immediate outcomes are selected over delayed rewards which offer greater benefit (Odum, 2011). Both constructs of impulsivity appear to capture an element of risky behaviour, whereby both disinhibited behaviours and impulsive decision-making are suggested to influence risk assessment and risk-taking behaviour (Reniers, Murphy, et al., 2016). Indeed, research suggests some overlap between the two (Courtney et al., 2012; Fernie et al., 2010; Stamatēs & Lau-Barraco, 2017), as elements of impulsivity may be regarded as risk-taking, and vice versa. For example, choosing the most attractive option, impulsively, without weighing up the consequences may be seen as risky, whereas risk-taking may at times be a result of calculated decision making, where impulsiveness does not appear to play a part (Courtney et al., 2012; Leigh, 1999; Stamatēs & Lau-Barraco, 2017), thus indicating these as non-synonymous constructs.

When investigating impulsivity and risk-taking (independently), both are largely measured via behavioural tasks in a laboratory, such as the Go/No-Go Task (Marczinski & Fillmore, 2003), and the balloon analogue risk task (Lejuez et al., 2002). While behavioural measures are useful as they are not confounded by self-report errors and misjudgements on one's own behaviour (Lane et al., 2003), they are also limited due to mostly capturing only specified elements of (impulsive) behaviour (B. Reynolds, Ortengren, et al., 2006). On the other hand, self-reports are able to measure multiple constructs of impulsivity and risk-taking in one questionnaire, thereby arguably capturing a broader picture of sub-traits of impulsivity or risk-taking, which may be influencing alcohol use (Dick et al., 2010). As self-report personality measures commonly capture stable traits (Lane et al., 2003; Stanford et al., 2009), their use may offer some understanding of the predictive utility of such traits. Alternatively, behavioural tasks measure state-dependent behaviours, which could explain the lack of

relationship between self-report and behavioural measures within impulsivity (Christiansen, Cole, & Goudie, 2012; Dougherty, Mathias, Marsh, Forest, & Carolina, 2005; Lane et al., 2003). Here, if self-reports capture more stable traits, these measures will likely reflect impulsiveness and risk-taking as determinants of alcohol use.

Alternatively, findings from behavioural measures may better represent these behaviours as a consequence of current state, such as intoxication (de Wit, 2008; M. Field, Wiers, Christiansen, Fillmore, & Verster, 2010; Jones et al., 2013; Lane et al., 2004).

### **Impulsivity and alcohol use**

Research using behavioural measures have displayed high impulsivity in heavy drinkers (Field, Christiansen, Cole, & Goudie, 2007; Henges & Marczinski, 2012; Weafer et al., 2011), although the causal pathway between heightened impulsivity and heavy drinking remains unclear (de Wit, 2008). However, the use of these measures in alcohol administration studies suggest that intoxication enhances impulsivity (Marczinski & Fillmore, 2003). The use of priming participants with a pre-determined quantity of alcohol prior to completing behavioural tasks provides a clear direction of causality, whereby heightened impulsive behaviour is a consequence of alcohol consumption. The predictive utility of these tasks on alcohol use may therefore be limited as differences in consumption may equally be the cause of the observed increases in impulsive behaviour.



On the other hand, the BIS-11 is a self-report measure of impulsivity<sup>7</sup>, which has repeatedly been found to predict variability in alcohol consumption (Henges & Marcziński, 2012; Stanford et al., 2009). The BIS-11 further measures sub-traits of attentional, motor, and non-planning impulsiveness, which have been investigated to a lesser extent (Stamates & Lau-Barraco, 2017). Here, Fernie et al. (2010) found that only the non-planning sub-trait of impulsivity predicted alcohol use, whereas Stamates and Lau-Barraco (2017) indicate the predictive utility of all BIS-11 sub-traits on varied drinking behaviour. For example, motor impulsivity was found to be predictive of quantity and frequency of alcohol use, whereas attentional and non-planning impulsiveness predicted alcohol use problems. Such findings therefore illustrate the importance of considering how multiple facets of impulsivity may predict different drinking behaviours. In this regard, the BIS-11 is seemingly a well-established, and reliable tool (Stanford et al., 2009), which may provide a more clear understanding of impulsivity as a determinant (opposed to a consequence) of alcohol use, relative to current behavioural measures.

### **Risk-taking and alcohol use**

Risk-taking has predominantly been investigated as an effect of intoxication (e.g., Berthelon & Gineyt, 2014; Burian, et al., 2002; Lane et al., 2004). Here, behavioural measurements have mostly implicated risk-taking as a consequence to alcohol consumption behaviour (Burian et al., 2002; Lane et al., 2004; Rose et al., 2014), whilst less research finds no influence of alcohol consumption on risky

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<sup>7</sup> One of the most commonly used self-report measures of impulsivity is the 30-item Barratt Impulsiveness Scale (BIS-11; Patton, Stanford, & Barratt, 1995), which measures overall impulsivity, and three sub-traits of attentional (an inability to focus attention or concentrate), motor (acting without thinking), and non-planning impulsiveness (orientated in the present with a lack of future-thinking) (Stanford et al., 2009).

behaviour (Euser et al., 2011; Peacock et al., 2013; S. C. Reed, Levin, & Evans, 2012). On the other hand, recent work has begun to delineate the predictive utility of risk-taking behaviour (opposed to impulsivity) (Courtney et al., 2012; Fernie et al., 2010) and assessment of risk (de Haan et al., 2015; Stamatēs & Lau-Barraco, 2017) on alcohol use, although research in this regard, is in its infancy.

Risk-taking has rarely been examined as a trait, and many self-reports have been domain specific and/or aimed at adolescence (de Haan et al., 2011). Considering the various aspects of risk-taking behaviour (including impulsive risk-taking), de Haan et al. (2011) developed a short 18-item risk-taking questionnaire (RT-18), incorporating questions from commonly used self-reports (Cloninger, Svrakic, & Przybeck, 1993; Eysenck & Eysenck, 1978; Zuckerman, Kuhlman, & Camac, 1988). The questionnaire includes two subscales measuring risk-taking assessment and behaviour, as well as risk-taking overall. The RT-18 has been found to significantly predict unique variance in binge drinking, quantity of alcohol consumption and alcohol use problems (de Haan et al., 2015; Stamatēs & Lau-Barraco, 2017). However the predictive utility of the subscales has been less consistent, highlighting only risk-taking behaviour as a significant predictor (Stamatēs & Lau-Barraco, 2017). The varied findings between the subscales and the diminutive research examining risk-taking as a determinant of alcohol use stresses the importance of considering the predictive utility of risk-taking behaviour not as a unidimensional construct, but as a multi-faceted concept (Dick et al., 2010).

In sum, gaining a more holistic understanding of impulsivity and risk-taking (as non-synonymous constructs) may contribute to understanding and identification of risk-factors, traits and/or behaviours that are most associated with unhealthy drinking

patterns. Furthermore, previous literature suggests that impulsivity and risk-taking comprise several important components which may differ in the extent to which they are associated with varied drinking behaviour. It is therefore important to explore these predictors on a diverse range of drinking behaviours.

The current study aimed to examine the predictive utility of impulsivity and risk-taking on a variety of alcohol consumption behaviours, utilising self-report measures consisting of the BIS-11, RT-18, and the alcohol use disorder identification test (AUDIT). Further it aimed to investigate how the sub-traits of impulsivity (attentional, motor and non-planning), and risk-taking (assessment and behaviour), are associated with consumption behaviours (including hazardous and harmful alcohol use, and dependence symptoms). It was hypothesised that both impulsivity and risk-taking behaviour independently and cumulatively predict unique variance in alcohol-use behaviours. However, it was also expected that the proportion of variation explained would vary between the differing alcohol-use measures.

## Method

### Design

An online survey was used to measure self-reported trait risk-taking and impulsivity, and alcohol consumption behaviour: hazardous and harmful alcohol use, and alcohol dependence symptoms.

### Participants and procedure

259 participants (190 female), with a mean age of 26.43 years ( $SD = 10.72$ ) completed the online survey having been recruited through opportunity sampling, facilitated by advertisements on an online participation pool (SONA), and (unpaid, organic) announcements on social media (Twitter and Facebook). Prior to completing the online survey, participants were presented with an information page, contact information, and an online consent form. Participants then completed the battery of questionnaires. The final page consisted of a debrief, which included researcher contact details and withdrawal information.

### Measures

**Alcohol Use Disorder Identification Test.** (AUDIT; Saunders, Aasland, Babor, De La Fuente, & Grant, 1993) The AUDIT consists of 10 questions which measure harmful and hazardous alcohol consumption. The test consists of three conceptual domains: hazardous alcohol use (frequency and quantity of drinking), dependence symptoms (control, saliency and morning drinking), and harmful alcohol use (guilt, blackouts, injury, and concern from others). Overall AUDIT scores, and domain scores were analysed. The AUDIT was found to have a high internal consistency in the current sample (Cronbach's  $\alpha = .74$ ).

**Barratt Impulsivity Scale.** (BIS-11; Patton et al., 1995). The BIS-11 measures overall trait impulsivity, and three further subscales of attentional, motor, and non-planning impulsiveness. The questionnaires consist of 30 statements which participants rate on a four-point scale from ‘strongly disagree’ to ‘strongly agree’. The total BIS-11 score and subscales were found to have acceptable internal consistency in the current sample (all Cronbach’s  $\alpha > .69$ ).

**RT-18 (de Haan et al., 2011).** The 18-item scale measures trait risk-taking whereby participants select a yes or no in response to a selection of questions such as “Would you enjoy parachute jumping?”. The RT-18 further assess two subscales: risk-assessment and risk-behaviour. All subscales and total RT-18 score had high internal consistency (all Cronbach’s  $\alpha > .79$ ).

## Results

### Analytic strategy

Following descriptive analyses (see Tables 2.1 and 2.2), a series of hierarchical multiple regressions were conducted to examine three separate alcohol consumption behaviours: hazardous alcohol use, dependence symptoms, and harmful alcohol use. Sub scales of trait impulsivity (BIS-11): attentional, motor and non-planning, and risk-taking (RT-18): assessment and behaviour, were entered as predictors into each model. Gender and age were entered into the regression models first in order to control for age and gender-related differences in risk-taking (Byrnes, Miller, & Schafer, 1999; Defoe, Dubas, Figner, & van Aken, 2015), impulsivity (Cross, Copping, & Campbell, 2011; Lauriola, Panno, Levin, & Lejuez, 2014), and alcohol use (Erol & Karpyak, 2015). Regression analysis was conducted for each AUDIT subscale in the following manner:

1. Step 1: age and gender. Step 2: BIS-11 subscales. Step 3: RT-18 subscales.
2. Step 1: age and gender. Step 2: RT-18 subscales. Step 3: BIS-11 subscales.

This method was used due to an absence of any assumptions regarding the leading predictor (between impulsivity and risk-taking) of alcohol consumption behaviour. All steps were analysed using forced entry method (for hierarchical multiple regression figures see Table 2.3). A Bonferroni adjusted *p*-value of .25 was used to control for Type 1 error. Correlational analysis was conducted to investigate the relationship between trait impulsivity and risk-taking subscales (see Table 2.2 for correlation matrix).

### **Preliminary analysis on age and gender**

A series of *t*-tests were conducted to investigate gender differences between impulsivity, risk-taking and alcohol consumption behaviours (see Table 2.1 for descriptive statistics). Males scored significantly higher than females on motor,  $t(257) = 2.24, p = .03, d = .32$ , and non-planning impulsivity,  $t(257) = 2.73, p = .007, d = .38$ , but did not differ on attentional impulsivity ( $p = .66$ ). Males also indicated greater risk-taking behaviour on the RT-18,  $t(257) = 3.17, p = .002, d = .45$ , whereas risk-taking assessment did not differ between genders ( $p = .10$ ).

Pearson's correlation was used to investigate any relation between age and impulsivity, risk-taking and alcohol consumption behaviour (see Table 2.2). Significant negative correlations were found suggesting that as age increased, attentional impulsivity, risk-taking behaviour, dependence symptoms and harmful alcohol use decreased ( $p < .005$ ). No other significant associations were found with age ( $p > .22$ ).

Table 2.1

*Descriptive and inferential statistics for alcohol consumption behaviour, impulsivity and risk-taking differences by gender.*

Variables	Male	Female	<i>P</i>
	<i>M (SD)</i>		
Hazardous alcohol use	6.01 (2.43)	5.59 (2.43)	.23
Dependence symptoms	1.12 (1.43)	1.01 (1.46)	.59
Harmful alcohol use	2.77 (2.46)	2.92 (2.94)	.71
BIS-11 Attentional	16.57 (4.12)	16.32 (3.88)	.66
BIS-11 Motor	23.87 (4.84)	22.43 (4.48)	.03
BIS-11 Non-Planning	25.23 (5.38)	23.28 (4.96)	.007
RT-18 Assessment	12.86 (2.53)	12.27 (2.52)	.10
RT-18 Behaviour	14.94 (2.39)	13.72 (2.86)	.002

### **Hazardous alcohol use**

Independently, neither age or gender predicted hazardous alcohol use at any stage of the analysis. When impulsivity was entered in step two, it significantly accounted for 8% of the variance in hazardous alcohol use. More specifically, hazardous alcohol use was significantly predicted by motor impulsivity ( $\beta = .21, p = .007$ ), but not by attentional or non-planning impulsiveness. Entering risk-taking to the model at step three accounted for an additional 2% of the variance but this did not reach significance (with Bonferroni adjusted *p*-value of .025),  $F(2, 252) = 3.29, p = .04$ . When risk-taking



was entered prior to impulsivity, it significantly accounted for 8% of the variance, with both subscales: assessment ( $\beta = .18, p = .005$ ) and behaviour ( $\beta = .17, p = .01$ ) significantly predicting hazardous alcohol use. Impulsivity then accounted for a further 2% of the variance, but did not reach significance.

Overall, a small but significant amount of variance (11%) in hazardous alcohol use was predicted by impulsivity and risk-taking in the final model (after controlling for age and gender),  $F(7, 251) = 4.46, p < .001, R^2 = .11$ . However, at this stage the predictive utility of individual impulsivity subscales was no longer significant, and the only significant subscale predictor of risk-taking was risk behaviour ( $\beta = .15, p = .02$ ).

### **Alcohol dependence symptoms**

Age and gender accounted for 3% of variance in step one. Only age was a significant predictor of alcohol dependence ( $\beta = -.18, p = .005$ ), and remained significant at steps two and three ( $p < .02$ ). When impulsivity was entered prior to risk-taking, it significantly accounted for 11% of the variance in dependence symptoms, however only the non-planning impulsivity subscale significantly predicted dependence symptoms scores ( $\beta = .18, p = .01$ ). In step three however, risk-taking did not significantly influence the variance accounted for in dependence symptoms,  $< 1\%$  ( $p = .27$ ). When entering risk-taking first (following controls), risk-taking assessment significantly predicted dependence symptoms ( $\beta = .26, p < .001$ ). Although risk-taking behaviour did not reach significance, overall risk-taking accounted for 8% of the variance in dependence scores. Impulsivity then accounted for a further 4% when included in step three.

In the final model, after control predictors, impulsivity and risk-taking together accounted for 15% of the variance in alcohol dependence symptoms,  $F(7, 251) = 6.30, p < .001, R^2 = .15$ . When all predictors were included, no impulsivity or risk-taking subscales significantly predicted dependence scores ( $ps > .07$ ) (excluding age).

### **Harmful alcohol use**

Step one of analysis found age and gender to account for 3% of the variance. Age was the only significant predictor at step one ( $\beta = -.18, p = .004$ ) and continued to predict harmful alcohol use at step two only ( $p < .01$ ). Both impulsivity and risk-taking significantly accounted for a further 11% of the variance respectively, when entered at step two, and 3% at step three. However, this added variance reached significance with only risk-taking ( $p = .01$ ) and not impulsivity ( $p = .04$ ) When impulsivity was entered first, no sub-traits of impulsiveness were identified as significant predictors. When entered before impulsivity subscales, risk-taking assessment predicted harmful alcohol use ( $\beta = .29, p < .001$ ), while risk-taking behaviour did not.

Overall, after controlling for age and gender, impulsivity and risk-taking accounted for 14% of variance in harmful alcohol use,  $F(7, 251) = 7.51, p < .001, R^2 = .17$ . When all predictors were within the model, only attentional impulsivity ( $\beta = .16, p = .025$ ) and risk-taking assessment ( $\beta = .19, p = .02$ ) predicted harmful alcohol use (excluding age).

### **Relationship between impulsivity and risk-taking**

Pearson's correlation was utilised to investigate the relationship between BIS-11 and RT-18 overall scores. There was a significant positive correlation,  $r = .59, p < .001$ . As impulsivity ( $M = 63.00, SD = 11.09$ ) increased, risk-taking increased ( $M = 26.47, SD = 4.40$ ). Furthermore, all subscales of impulsivity and risk-taking behaviour significantly correlated (see Table 2.2). However, correlations were small to medium, with only one strong correlation ( $r > .50$ ) revealed with motor impulsivity and risk-taking behaviour ( $r = .66$ ).

Table 2.2

*Summary of intercorrelations, means, and standard deviations for alcohol consumption behaviour, impulsivity and risk-taking subscales.*

Measure	1	2	3	4	5	6	7	8	9	M	SD
1. Hazardous alcohol use	---									5.70	2.51
2. Dependence symptoms	.42***	---								1.03	1.45
3. Harmful alcohol use	.46***	.56***	---							2.88	2.82
4. BIS-11 Attentional	.12	.27***	.29***	---						16.39	3.94
5. BIS-11 Motor	.26***	.27***	.28***	.48***	---					22.81	4.61
6. BIS-11 Non-planning	.23***	.29***	.25***	.43***	.53***	---				23.80	5.14
7. RT-18 Assessment	.25***	.28***	.32***	.35***	.66***	.57***	---			12.42	2.53
8. RT-18 Behaviour	.25***	.18**	.23***	.16**	.37***	.25***	.37***	---		14.05	2.79
9. Age	-.08	-.18**	-.18**	-.18**	-.04	-.02	-.01	-.22***	---	26.43	10.72

*Note.*  $N = 259$ , \* $p < .05$ , \*\* $p < .01$  \*\*\* $p < .001$

Table 2.3

*Hierarchical multiple regression analysis displaying the predictive utility of impulsivity and risk-taking traits on alcohol consumption behaviour*

Predictor	Hazardous Alcohol Use		Dependence Symptoms		Harmful Alcohol Use	
	$\Delta R^2$	B	$\Delta R^2$	B	$\Delta R^2$	B
Step 1: Controls	.01		.03*		.03*	
Age		-.07		-.18**		-.18**
Gender		-.07		-.02		.04
<b><i>Age – BIS – RT</i></b>						
Step 2: BIS-11	.08***		.11***		.11***	
Attentional		-.06		.11		.14
Motor		.21**		.12		.15
Non-Planning		.14		.18*		.12
Step 3: RT-18	.02		.009		.03*	
<b><i>Age – RT – BIS</i></b>						
Step 2: RT-18	.08***		.08***		.11***	
Assessment		.18**		.26***		.29***
Behaviour		.17*		.05		.09
Step 3: BIS-11	.02		.04*		.03	
<b><i>Step 3: Overall</i></b>						
Attentional		-.04		.12		.16*
Motor		.12		.04		.02
Non-Planning		.11		.14		.05
Assessment		.06		.11		.19*
Behaviour		.15*		.05		.10
Total $R^2$	.11***		.15***		.17***	
$R^2$ (minus controls)	.10***		.12***		.14***	

Note:  $N = 258$ . Total  $R^2$  is based on predictors of age, BIS-11 subscales and RT-18 subscales. \* $p < .025$ , \*\* $p < .001$

## Discussion

The main aim of the current research was to investigate the respective and combined utility of impulsivity and risk-taking behaviour in predicting various alcohol consumption behaviours. After controlling for gender and age, impulsivity and risk-taking combined accounted for a significant amount of variance in alcohol consumption behaviour: 10% in hazardous alcohol use, 12% in dependence symptoms, and 14% in harmful alcohol use. Independently, impulsivity and risk-taking predicted similar variance on alcohol use (the largest difference was 3%), and the addition of either construct contributed only 2-4%, thus suggesting some overlap between the two. The subscales of each construct accounted for differing variance across the alcohol consumption types (hazardous, harmful and dependent), therefore supporting the complexity of both impulsivity and risk-taking as multi-faceted concepts.

In line with previous work (Stamates & Lau-Barraco, 2017), after controlling for gender and age, impulsivity was found to predict 8% of the variance in hazardous alcohol consumption. This amount appears to be nearly half of that suggested by Fernie et al. (2010), who found 15% of alcohol use explained by impulsivity via the BIS-11. However, in Fernie et al. (2010) several questionnaires were used to compile an 'alcohol use index' which may have obscured different alcohol consumption behaviours. It could therefore be the case, that impulsiveness in this regard is capturing multiple drinking behaviours, which may result in larger variances explained. In the current study, impulsiveness further accounted for 11% of harmful alcohol use and dependence symptoms. As few studies have examined the predictive utility of the BIS-11 on distinct drinking behaviours, these findings are somewhat difficult to evaluate in light of previous work. To this end, the current findings offer some initial considerations

regarding the impact of impulsiveness personality traits on a variety of alcohol consumption behaviours. As such, higher levels of impulsiveness are indicated as potential risk-factors contributing to some extent, to the quantity and frequency of drinking, alcohol use symptomatic of dependence, and alcohol-related harms.

The current findings also support the contention that impulsivity should be conceptualised as a multifaceted construct (Jentsch et al., 2014; Patton et al., 1995; Stanford et al., 2009). Specifically, it was found that the sub-traits of impulsivity differed in their capacity to account for varying alcohol consumption behaviours. However, although overall impulsivity predicted a significant amount of variance in harmful alcohol use, no single sub-trait was associated with this drinking behaviour when entered into the model prior to risk-taking. The lack of association between harmful use and motor impulsivity is comparable to previous research (Stamates & Lau-Barraco, 2017), although the limited predictive utility of attentional impulsiveness is inconsistent with such former work.. Differing from harmful drinking, increased scores of dependence symptoms was found to be related to non-planning impulsivity, while motor impulsiveness was the only sub-trait associated with hazardous alcohol use, providing some support for the association found between behavioural disinhibition (similar to motor impulsivity) and heavy drinking in previous studies (Henges & Marcuzinski, 2012; Weafer et al., 2011). The current study therefore highlights the differential relationships between impulsivity subscales and alcohol consumption measures, whereby various impulsiveness traits may predict differing consumption behaviours. In doing so, the current study highlights the need to avoid overly narrow investigation of the role of impulsivity in problematic alcohol use.

Independent of the BIS-11, risk-taking accounted for a similar amount of variance as impulsivity in alcohol consumption behaviour, when entered first in the model. However, risk-taking accounted for less change in dependence symptoms measured by the AUDIT, compared to impulsivity (8 and 11% respectively), and did not account for a significant change in variance when entered after the BIS-11. This may suggest that alcohol consumption behaviours potentially symptomatic of dependency issues (on the AUDIT) are partially attributable to impulsiveness, opposed to general propensity to take risk. As such, it is plausible that variance explained by the RT-18 when entered prior to the BIS-11, is symptomatic of the impulsive element to risk-taking behaviour, further supporting an overlap between the two constructs (Courtney et al., 2012; Fernie et al., 2010). To my knowledge, only two studies (de Haan et al., 2015; Stamates & Lau-barraco, 2017) have examined scores on the RT-18 as a determinant of alcohol use, neither examining the AUDIT dimension of dependence symptoms. By supporting an association between impulsiveness personality traits (above risk-taking propensity) and dependency symptoms on the AUDIT, findings build on research efforts, contributing to our understanding of impulsive risk-taking as a possible risk-factor of alcohol consumption which is potentially symptomatic of dependency.

The RT-18 related most to harmful drinking behaviour, which is consistent with the literature concluding a relationship between alcohol consumption and injury through engagement in harmful risky behaviours (Taylor et al., 2010). Looking more specifically at the subscales, risk behaviour was only associated with hazardous alcohol use, whereas risk assessment significantly predicted all alcohol consumption behaviours measured in the current study. This research therefore posits that the way in which an individual appraises a risky situation may influence problematic alcohol use.



Specifically, this illustrates to the importance of risk appraisal, as those who are prone to judge situations as less risky, appear more likely to engage in potentially harmful alcohol use (de Haan et al., 2015). As such, the current findings may offer worthwhile considerations for inducing safer drinking behaviours, whereby efforts may benefit by targeting individual's assessment of alcohol risks.

Impulsivity and risk-taking together, accounted for a similar significant amount of variance in all alcohol consumption behaviours measured (between 10-14%). Regression models for both dependence symptoms were significantly improved by the inclusion of impulsivity into models already containing risk-taking. Moreover, the addition of risk-taking into models of harmful alcohol use (at the final stage) significantly increased the variance explained. However, although these changes were significant, the added variance explained was small (2-4%), and was between 6-8% less than when entered at step two opposed to step three. The reduction in variance explained when added to the model last, suggests some overlap between the two constructs. Here, if distinct (and not related) from one another, the variance explained by each construct would not change dramatically regardless of whether it is entered before or after the other, which was not the case in the current findings. Moreover, in contrast to the only study to my knowledge which measures both the RT-18 and BIS-11 (Stamates & Lau-Barraco, 2017), impulsivity and risk-taking subscales were all significantly correlated in the current study, further supporting a degree of overlap between the two traits. Therefore in support of previous studies, the findings highlight that although impulsivity and risk-taking do appear distinct from one another, there is overlap between the two traits (Courtney et al., 2012; Fernie et al., 2010). Although an overlap is supported, the significant predictive contribution of both impulsivity and risk-taking behaviour respectively when entered into the regression model last, demonstrates

the need to still consider these as distinct constructs. In other words, current findings suggest that it is important to not assume all risk-taking characteristics encompasses impulsiveness, and vice versa.

Finally, in consideration of reported age and gender differences in impulsivity (Cross et al., 2011; Lauriola et al., 2014), risk-taking (Byrnes et al., 1999; Defoe et al., 2015), and alcohol use behaviours (Erol & Karpyak, 2015), the first stage of each model included age and gender as controls. Inconsistent with previous research (Livingston & Room, 2009), gender did not predict any alcohol consumption behaviour. However, *t*-tests did reveal enhanced motor and non-planning impulsivity, and risk-behaviour in males. Increasing age significantly predicted reduced dependence symptoms and harmful alcohol use (3% explained variance respectively), but not hazardous alcohol consumption (comprised of quantity and frequency of consumption). Russell, Light, and Gruenewald (2004) suggest alcohol quantity decreases with age, whereas frequency increases. These opposing associations may therefore cancel each other out, resulting in no association between age and hazardous alcohol use. The impulsivity differences found between genders, and age associations with alcohol-consumption behaviour, support the chosen controls in the current study and further highlight the importance of considering these factors when investigating impulsive and risky behaviours, and alcohol use.

This study should be interpreted in light of limitations. The current study utilised self-reports based on the assumption that impulsivity and propensity to take risks, as determinants to alcohol use, are stable traits and thus suitable for questionnaire assessment, opposed to state-dependent behavioural measures (Lane et al., 2003).

However, future research may benefit from the implementation of a number of approaches: First, adopting longitudinal research designs examining impulsivity, risk-taking behaviour and alcohol consumption over time, to more confidentially ascertain the direction of causality. Second, the sole use of self-reports relies on participants awareness and accurate recall of their own behaviour (Dougherty et al., 2005), and rarely correlate with behavioural measures of impulsivity (Christiansen, Cole, & Goudie, 2012; Lane et al., 2003). As such, further investigation in this area would benefit from incorporating both self-report and behavioural measures. Moreover, the sample used in the current study included both university students, and more widely, the general population (from social media advertisements). Exploration into the role of impulsivity and risky behaviour on alcohol use may benefit from investigating purposeful samples, such as heavy drinkers. In this regard, intervention efforts would benefit from more valid generalisation back to these populations.

Finally, to investigate the likelihood of detecting significant findings and related power in the multiple regression analyses, a post-hoc power analysis using G\*Power 3.1.9.2 (Erdfelder, Faul, & Buchner, 1996), with the sample size of 258 and a seven-predictor variable equation was used as a baseline. The effect sizes used were as recommended by Cohen (1977):  $f^2 = 0.02$  (small),  $f^2 = 0.15$  (medium) and  $f^2 = 0.35$  (large), and the alpha level was set at  $p < .05$ . The analyses showed that the statistical power was 0.32 for detection of a small effect, but over 0.99 for detection of a medium to large effect size. Therefore, there was sufficient power (above 0.8) for the medium to large effect size level, but less than sufficient power at the small effect size level.

In conclusion, the study aimed to investigate the independent and combined influence of impulsivity and risk-taking on a variety of alcohol consumption behaviours, whilst also considering the multi-faceted nature of both personality traits. To this end, the study found that impulsivity and risk-taking (respectively and combined) accounted for a significant amount of variance in hazardous alcohol use, dependence symptoms, and harmful alcohol use. Furthermore, sub-traits of impulsivity (attentional, motor and non-planning) and risk-taking varied in their predictive utility of the varying alcohol consumption behaviours, highlighting the importance of considering both as complex, multi-faceted constructs. Finally, the study found impulsivity and risk-taking to be mostly distinct, in that significant change variance was revealed for most alcohol consumption behaviours, by the addition of each trait in the model. However, as the difference was small (yet significant), and subscales of both impulsivity and risk-taking are associated, findings point to some overlap between the two concepts. Future research would benefit from longitudinal designs to unpick the relationship between these factors, and more confidently establish a direction of causality. Overall, the current study highlights the importance in considering both the multifaceted and distinct constructs of impulsivity and risk-taking behaviour, and their association with problematic alcohol consumption. Addressing trait level differences in these factors may benefit invention efforts to identify potential risk-factors and reduce the prevalence of problematic alcohol use.

### **Chapter Conclusion**

Chapter 2 (Study 1) aimed to investigate the role of risk-taking and impulsive personality traits on a range of alcohol consumption patterns. The purpose being, to identify the role of risk-taking in alcohol use, in addition to the causal effect of alcohol

on risky behaviour presented in subsequent chapters (Chapter 3 and 4). In other words, this chapter investigates the potential role of risk-taking as determinant of alcohol use, whereas subsequent chapters will explore risky behaviour as a consequence of alcohol consumption. Using a survey design, this chapter found trait impulsiveness and risk-taking combined to predict hazardous and harmful alcohol use, and dependence symptoms as measured by the AUDIT. Findings further point towards the overlap between risk-taking and impulsive personalities, whilst also suggesting some distinction between the two. The findings inform subsequent studies within the thesis by highlighting the importance of measuring such personality characteristics in order to control for any group level differences in research investigating the role of alcohol on risky behaviour.

## Chapter 3 Study 2

### Abstract

**Background:** Research addressing the influence of alcohol and groups on risky behaviour has yielded contradictory findings regarding the extent to which intoxicated groups exaggerate or minimise risk-taking. Previous work has examined the effect of intoxication on risk-taking focusing on collective group decision-making, and to date the influence of alcohol consumption and groups on individual risk-taking has yet to be explored experimentally. The current study therefore examined the impact of intoxication and groups on individual risk-taking. **Methods:** In a mixed design, 99 social drinkers (62 female) attended an experimental session individually ( $N = 48$ ) or in groups of three ( $N = 51$ ). Individuals completed the study in isolation while groups were tested in the same room. Participants completed two behavioural measures of risk-taking: Balloon Analogue Risk Task (BART) and Stoplight Task (SLT), both before and following consumption of an alcoholic (0.6g/kg males, 0.5g/kg females) or a placebo beverage. **Results:** Those who participated in groups took significantly more risks in both tasks than those in isolation. Alcohol did not increase risk-taking on either risk-taking tasks. However, those who consumed placebo were significantly less risky on the SLT, compared to baseline. No interactions were found between context and beverage on risk-taking. **Conclusion:** The findings do not support a combined effect of alcohol and groups on individual risk-taking. Rather, results indicate that risk-taking behaviour is influenced by peer presence regardless of alcohol consumption. Targeting the influence of groups (above those of alcohol) may hold promise for reducing risk-taking behaviours in drinking environments.

## Introduction

Alcohol is a social lubricant and forms the basis of a variety of social celebrations, cultural and religious events (Gordon et al., 2012). However, in addition to well-documented adverse impacts on health and well-being (WHO, 2014), research suggests that alcohol consumption can be associated with a variety of potentially harmful risky behaviours, including aggression (Ito et al., 1996), drink-driving (Taylor et al., 2010), and sexual risk-taking (Rehm et al., 2012). Given that alcohol is frequently consumed in groups, it is noteworthy that much alcohol-related risk-taking research has been conducted on individuals in isolated contexts. While research into the impact of social contexts on alcohol-induced risk has begun to address this shortcoming, findings to date are inconsistent (Abrams et al., 2006; Sayette, Dimoff, et al., 2012), and more research is needed to better understand how social contexts and alcohol consumption interact to shape risky behaviours. A fuller account of how the psychopharmacological effects of alcohol are shaped by different social settings to impact risk-taking behaviours may also be important for informing interventions that are sensitive to the different contexts in which people become intoxicated.

In a rare exception to the dearth of research examining alcohol-induced risk taking in social contexts, Sayette, Dimoff, et al. (2012) found that intoxicated groups made riskier decisions than sober groups. However, they found that risky choices did not differ between sober and intoxicated individuals when the risk-taking decisions were made in isolation. This research therefore points to a negative impact of social influences on alcohol-induced risk-taking, whereby alcohol consumption may only enhance risk-taking behaviour within groups. In contrast, Abrams et al. (2006) and Hothrow et al. (2014) found that the extent to which group members were attracted to risk appeared either not to differ (Abrams et al., 2006) or was lesser (Hothrow et al.,

2014) as a function of intoxication, whereas those in socially isolated contexts appeared more risk-taking following alcohol consumption. This work therefore suggests a protective effect of groups on risk-taking associated with alcohol consumption.

Addressing these inconsistent findings, it is worthwhile to consider methodological differences regarding the contexts in which beverages were consumed between studies. Sayette, Dimoff, et al. (2012) consistently administered beverages in groups, subsequently extricating some group members for individual assessment of decision-making. On the other hand, Abrams et al. (2006) kept testing contexts consistent throughout the study, with participants who completed the risk task alone also consuming their beverages in isolation, compared to groups who both drank and completed the task with peers. The varied drinking contexts utilised in these studies may help explain the inconsistent findings, as participants may respond differently following social drinking (Sayette, Dimoff, et al., 2012), compared to drinking in isolation (Abrams et al., 2006).

In addition to the methodological differences between these studies, it is also important to distinguish between collective group risk-taking and group influence on individual risk-taking. Both Abrams et al. (2006) and Sayette, Dimoff, et al. (2012) examined group risk-taking as one collective decision within the group, as opposed to group member's personal decisions. Notably, Frings et al. (2008) found intoxication to increase vigilance errors in individuals, whereas errors made in groups (collectively and privately by group members) remained unaffected by alcohol consumption. However, vigilance errors did appear to differ depending on whether group members made their judgements privately, or collectively. Here, collective group decisions were found to be less erroneous. Moreover, risk preferences appear to be influenced by the presence of



peers to a greater extent when tasks are discussed with the group, in contrast to when group members complete tasks independently (Centifanti, Modecki, Maclellan, & Gowling, 2016). This highlights the necessity to distinguish between collective group decisions, and individual decisions within a group. However, group influence on individual risk-taking has not yet been examined experimentally in intoxicated groups. The impact of social drinking on individual, as opposed to collective (group), risk-taking therefore remains unclear.

Theoretically, the impact of peer presence and alcohol on risk taking behaviours may be explained via cognitive and social influence frameworks such as the alcohol myopia model (AMM; Steele and Josephs, 1990) and perceived norms (Borsari and Carey, 2001). AMM postulates that the pharmacological effects of alcohol narrow an individual's attention to the most salient cues, thereby constricting individuals' focus. This is seen to impede attempts at evaluating systematically a given situation (Steele and Josephs, 1990), resulting in increases in risky behaviour (Lane et al., 2004; Rose et al., 2014). Furthermore, in social contexts the saliency of group membership may result in an alcohol-related focal narrowing of attention towards peers (Hopthrow et al., 2007), leading to subsequent behaviour to be driven by, and evaluated in light of, peer approval.

Beliefs regarding the alcohol consumption behaviours of one's social group may also be an important determinant of alcohol-related behaviours (Borsari and Carey, 2001). For instance, young adults and students in social groups often overestimate their peers' risky drinking behaviour (Martens et al., 2006). In turn, this (mis)perception has been suggested to predict behaviour as individuals attempt to match their conduct to the perceived norm (Crawford & Novak, 2010; Kenney et al., 2013; Martens et al., 2006).

In social contexts, alcohol-related increases in attention to one's peers may thereby lead to norm-driven heightened risky drinking behaviour.

In summary, it may be suggested that the effects of alcohol are likely to enhance risky behaviour due to pharmacologically-driven myopia impairing systematic evaluation of consequences. In social contexts, a narrowed focus may be directed towards peers, influencing behaviour in line with perceived group norms, which may overestimate peer engagement in risky drinking behaviour (Kenney et al., 2013; Martens et al., 2006). The effect of alcohol consumption on individual risk-taking might therefore be expected to be exaggerated in the presence of peers.

The current study therefore aimed to investigate the influence of group context, specifically peer presence, and alcohol consumption on individual risk-taking behaviour. Risk-taking was assessed both before and after consumption of 0.5-0.6g/kg alcohol or a placebo, across two varying contexts (a group or an isolated context). The study investigated both the independent and combined effects of groups and alcohol consumption on individual risk-taking. It was expected that (a) alcohol and (b) group context will increase individual risk-taking behaviour. Additionally, we hypothesised that (c) the combination of both alcohol consumption and group context would elevate risk-taking behaviour further.

## **Method**

### **Design**

A 2 (Context: Group vs. Isolation) x 2 (Beverage: Alcohol vs. Placebo) mixed design was used. Risk-taking behaviour was a repeated variable, due to measurement before and following beverages.

### **Ethical considerations**

The research was conducted in line with both The British Psychological Society's (BPS) Code of Human Research Ethics (The British Psychological Society, 2014) and the National Institute on Alcohol Abuse and Alcoholism (NIAAA, n.d.), and was approved by Departmental Research Ethics Committee.

Prior to participation, potential participants were informed of the possibility of intoxication, and the type and quantity of alcohol which would be consumed. An online or face to face screening further assessed eligibility by confirming that participants were social drinkers who consumed alcohol at least once per week as it would be unethical to administer alcohol to participants who do not regularly drink. Here, participants were also screened for any medical concerns (including current medication) which could be affected by alcohol administration. Additionally, anybody who was alcohol dependent, receiving treatment or had previously received treatment for alcohol-related issues, or individuals who were trying to reduce their alcohol intake were not permitted to participate (measured via questions in the medical screening, see Appendix A). Female participants were further requested to confirm that there was no possibility of pregnancy, and they were not trying to conceive, and were subsequently offered a pregnancy test if required.

When participants arrived at the experimental session, they were breathalysed to ensure a breath alcohol concentration (BrAC) of 0.0mg/l (absence of any alcohol). Participants consented to not drive, ride a bike, swim, or operate any machinery for a minimum of 4 hours after leaving the laboratory. The information sheet further informed participants that they were requested to stay within the laboratory until their BrAC was  $\leq 0.14$ mg/l, for their own safety. If participants insisted on leaving then they were required to sign a waiver agreeing not to hold the university or any employee of the university responsible for any adverse reactions upon leaving. Finally, a full debrief was conducted, informing participants of the study aims, drink they consumed (placebo or alcohol), and provision of contacts and websites or information and advice about drinking. Participants were informed that they could withdraw from the study at any time without penalty, and would not need to surrender their participation reimbursement or course credits.

### **Participants<sup>8</sup>**

A total of 99 social drinkers (62 female,  $M$  age = 20.71 years,  $SD$  = 4.34) were recruited by opportunity sampling at a UK University. Recruitment was facilitated by online and campus advertisements, as well as via an online participation pool (SONA). Participants signed up to the study either individually or as a group of three (to recruit natural friendship groups). Participation requirements were that volunteers reported drinking alcohol with others at least once per month and were not pregnant, trying to reduce their alcohol use, or had any history of alcohol-related issues. The gender of group members was recorded due to the possibility of gender composition in group

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<sup>8</sup> Post-hoc power analyses conducted using G\*Power 3.1.9.2 revealed a power of .7, reasonably close to the recommended level of .80.

contexts impacting risk-taking behaviours (Hannagan & Larimer, 2010; Karakowsky & Elangovan, 2001). Six same sex groups (four female) and 11 mixed sex groups (six female-dominated) took part in this study. The proportion of different group gender make-up was comparable across alcohol and placebo conditions ( $p = 1.00$ , Fisher's exact test). In the alcohol condition 11% of groups were all male, 22% all female, and 67% mixed. Similarly, of the groups consuming a placebo 12% were all male, 25% all female, and 63% mixed.

## **Materials and measures**

**Beverage Administration.** The methods utilised for beverage administration were adapted from previous studies (Abrams et al., 2006; Rose & Duka, 2006). Using a single blind procedure, participants were randomly assigned to one of two beverage conditions: alcohol or placebo. Prior to consumption, participants were asked to eat a strong-tasting lozenge (Fisherman's Friend) to mask the taste of the beverages. The alcoholic beverage contained 0.5g/kg (females) or 0.6g/kg (males) of alcohol (vodka), mixed with equal parts of orange juice and tonic water. For the placebo condition, participants were administered equal parts of orange juice and tonic water with a vodka mist sprayed over and on to the rim of the glasses. Beverages were divided between three glasses which participants consumed the contents within 10 minutes.

## **Self-Report Measures**

**Medical Screening** was conducted in line with the national institute on alcohol abuse and alcoholism (NIAAA) guidelines for alcohol administration. The screening assessed current health status and medications, risk of alcohol-related problems, and previous issues regarding alcohol intake.

*Alcohol Use Disorder Identification Test (AUDIT)* (Saunders et al., 1993) consists of 10 questions, which identifies harmful and hazardous alcohol use. The measure has high internal consistency (Cronbach's  $\alpha = .82$ ) (Shields, Guttmanova, & Caruso, 2004).

*RT-18* (de Haan et al., 2011) consists of 18 questions measuring risk-taking behaviour. The RT-18 shows high internal consistency when used in young adult social drinkers (Cronbach's  $\alpha = .80$ ) (de Haan et al., 2011). The RT-18 has been implicated in predicting alcohol consumption behaviours (de Haan et al., 2015; Stamatou and Lauer-Barraco, 2017) and it was therefore assessed to ascertain any group level differences in trait risk-taking.

*Subjective Intoxication Visual Analogue Scales (SI VAS)* are 100mm long with anchors of 'not at all' (0mm) and 'extremely' (100mm). Participants were asked to indicate the extent to which they felt drunk, dizzy, clearheaded and able to concentrate on the scale.

### **Behavioural Measures of Risk-Taking**

*Balloon Analogue Risk Task (BART)* (Lejuez et al., 2002) is a computerised task where participants are instructed to pump up a balloon to earn points, over one practice and 30 test trials. More points are awarded the more the balloon inflates. Participants are informed that the balloon may burst at any time resulting in the loss of points earned and they must therefore choose when to stop inflating the balloon and

bank the points earned. In line with previous research (Fernie et al., 2010; Rose et al., 2014), the average number of pumps for successful trials were recorded, with more pumps indicating riskier behaviour. The BART has found to be sensitive to an alcohol dose of 0.6g/kg, 20 minutes post-consumption (Rose et al., 2014), and has been successfully utilised in a number of studies examining the impact of social context on risk-taking behaviour (McCoy & Natsuaki, 2017; Reniers, Beavan, et al., 2016).

*Stoplight Task (SLT)* (Chein et al., 2011) is a computerised driving task in which participants are given the goal of reaching a radio station in the quickest time possible, crossing 32 intersections. Participants are informed that at each intersection, they will see a stoplight turn from green to amber to red, and are required to make the decision to stop the car (incurring a three second wait), or to continue through the intersection (risking a collision which would result in a six second wait, whilst there would be no penalty incursion if a collision is avoided). Participants were required to view a demo of the task before commencing the full SLT, which talked them through instructions and provided examples of the actions they could choose, and possible outcomes. The timing of traffic signals and probability of a crash was varied, to ensure that participants cannot predict future intersections (as in Chein et al., 2011). Risky behaviour was measured by the proportion of times participants continue through, regardless of whether this results in success or a crash. To our knowledge, the SLT has not yet been used in alcohol administration studies. However, it has been successfully used as a measure of risk-taking, and has appeared to be sensitive to the presence of peers (Albert, Chein, & Steinberg, 2013; Chein et al., 2011).

## Procedure

Following ethical approval, potential participants were required to complete a screening (medical questionnaire and AUDIT) and supply written informed consent before participation. Following this, an experimental session was scheduled and participants were asked to refrain from eating for three hours and from consuming alcohol for 12 hours prior to participation. Testing took place Monday-Friday after 12pm and was carried out in individual or group testing laboratories (identical in terms of décor and noise), depending on context condition. Participants arrived at the session individually or with their natural friendship group and were breathalysed using the Lion Alcolmeter® 400, to ensure a BrAC of 0.00mg/l prior to testing. On commencement of the study, participants were asked to individually complete the RT-18 and SI VAS. Additionally, those who participated in groups were required to complete two questions confirming whether they were friends or acquaintances, and how often they drink alcohol with the other members of their group (never, occasionally or frequently). Participants then completed the BART and SLT (counterbalanced). In the group condition, participants were seated next to each other whilst performing these tasks individually to obtain their own individual risk-taking score. They were permitted to communicate with one another during the tasks to imitate a social environment, but were requested to not discuss the tasks or any element of the study.

Immediately after completion of the risk tasks, participants were asked to consume either alcoholic or placebo beverages. Following this, a 20-minute rest period was given to ensure testing took place on the ascending limb of the blood alcohol curve (Rose & Duka, 2006). Participants were then breathalysed before completing the SI VAS. A fake breathalyser score of between 0.35-0.40mg/l was recorded for those in the placebo condition. Such scores mimic those from previous research examining BrAC 20



minutes following consumption of 0.5-6g/kg of alcohol. (Rose et al., 2014; Veldstra et al., 2012) and were provided to strengthen the belief that alcohol had been consumed for those who were given a placebo. Participants then completed the BART and SLT for a second time. Finally, participants were debriefed and breathalysed. Participants with BrAC scores above 0.14mg/l were asked to stay within the laboratory. Those that expressed a need to leave were required to sign a disclaimer.

## Results

### Preliminary analyses and placebo manipulation checks

**Participant Characteristics.** Preliminary analyses revealed that participants did not differ in terms of age or gender between beverage or context conditions ( $p > .05$ ). Participants did however, have significantly higher AUDIT scores in the alcohol beverage condition ( $M = 12.09, SD = 4.99$ ), compared to placebo ( $M = 9.98, SD = 4.47$ ),  $F(1,95) = 4.62, p = .03, \eta_p^2 = .04$ . RT-18 scores also differed significantly across conditions, as those tested within groups had significantly higher trait risk-taking scores ( $M = 10.18, SD = 3.66$ ) compared to those tested in isolation ( $M = 8.40, SD = 3.88$ ),  $F(1,95) = 5.29, p = .02, \eta_p^2 = .05$ . All participants tested in groups ( $N = 51$ ) reported being friends, opposed to acquaintances, and confirmed that they engage in social drinking with their group members either occasionally (41%,  $N = 21$ ) or regularly (59%,  $N = 30$ ). For further descriptive statistics by condition, see Table 3.1.

Table 3.1

*Descriptive statistics by context and beverage (means and standard deviations)*

Variables	Individual			Group			Overall
	Alcohol (N = 23)	Placebo (N = 25)	Overall (N = 48)	Alcohol (N = 27)	Placebo (N = 24)	Overall (N = 51)	(N = 99)
	<i>M(SD)</i>			<i>M(SD)</i>			<i>M(SD)</i>
Age	20.78 (5.29)	20.48 (3.29)	20.63 (4.32)	22.15 (5.61)	19.25 (1.39)	20.78 (4.41)	20.71 (4.34)
AUDIT	11.70 (4.68)	9.96 (5.11)	10.79 (4.94)	12.41 (5.31)	10.00 (3.80)	11.27 (4.77)	11.04 (4.84)
RT-18	8.61 (4.20)	8.20 (3.64)	8.40 (3.88)	10.38 (3.51)	9.95 (3.88)	10.18 (3.66)	9.30 (3.85)
BrAC	.34 (.13)	-	-	.33 (.10)	-	-	.33 (.11)**
BART (t1)*	35.92 (17.18)	36.05 (18.12)	35.99 (17.49)	38.86 (19.72)	45.22 (12.80)	41.85 (16.97)	39.01 (17.39)
BART (t2)*	39.59 (17.23)	41.52 (17.90)	40.60 (17.42)	47.35 (19.11)	50.26 (12.64)	48.72 (16.30)	44.78 (17.26)
SLT (t1)*	.27 (.13)	.33 (.14)	.30 (.14)	.34 (.19)	.45 (.17)	.39 (.19)	.35 (.17)
SLT (t2)*	.24 (.15)	.22 (.16)	.23 (.15)	.29 (.24)	.36 (.18)	.32 (.22)	.28 (.19)

*Note.* \*t1 = baseline, t2 = 20 minutes after beverage consumption. \*\* N = 50

**Gender Composition and Risk-Taking.** A 4 (Gender: Male, Female, Male Mixed or Female Mixed) X 2 (Beverage: Alcohol vs. Placebo) X 2 (Time: Pre and Post-Beverage) repeated measures ANCOVA was conducted, controlling for AUDIT and RT-18 scores.

Analysis did not reveal a significant main effect of group gender composition on risk-taking behaviour via the BART,  $F(1,41) = 2.47, p = .076, \eta_p^2 = .16$ , or the SLT,  $F(1,41) = .83, p = .49, \eta_p^2 = .06$ . Further there was no interaction of group gender composition and beverage on the BART,  $F(1,41) = .36, p = .78, \eta_p^2 = .03$ , or the SLT,  $F(1,41) = 2.28, p = .09, \eta_p^2 = .14$ .

**BrAC and Placebo Manipulation Checks.** Participants were breathalysed 20 minutes following alcohol consumption, indicating a mean BrAC of .33mg/l ( $SD = .11$ ). Subjective intoxication increased significantly from baseline for both participants that had consumed alcohol,  $t(49) = 13.13, p < .001, d = 2.54$ , and placebo,  $t(48) = 7.07, p < .001, d = .95$ . Further, participants who had consumed alcohol ( $M = 202.71, SD = 77.80$ ) reported significantly higher intoxication 20 minutes' post-beverage than those who consumed placebo ( $M = 104.69, SD = 59.21$ ),  $t(97) = 7.04, p < .001, d = 1.42$ .

#### **Analytic strategy: main analysis**

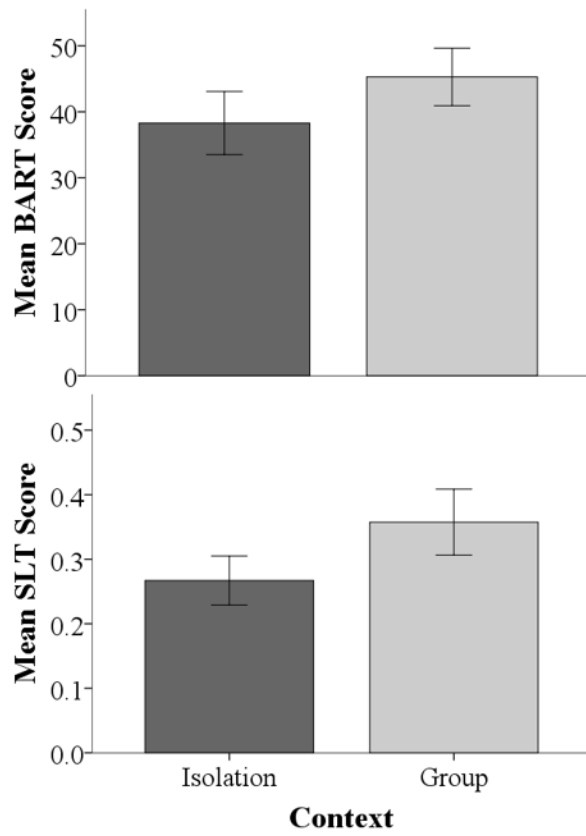
A series of 2 (Context: Group vs. Isolation) x 2 (Beverage: Alcohol vs. Placebo) x 2 (Time: Pre vs. Post-Beverage) mixed ANCOVAs were conducted, for BART and SLT, whilst controlling for condition variations identified with alcohol consumption (AUDIT) and trait risk-taking (RT-18). BART and SLT were measured twice: time one at baseline and time two at 20 minutes' post-beverage. Time was therefore the only

repeated measure variable. To determine an effect of beverage, an interaction of time and beverage were examined. A further 2 (Context) x 2 (Beverage) x 3 (BART Block: repeated variable) mixed ANCOVA analysis was conducted by splitting the post-beverage BART trials into 3 blocks: trials (1) 1-10, (2) 11-20, and (3) 21-30. The aim was to examine any change in risky behaviour during the task, based on beverage consumed (as found in Euser et al., 2011), and testing context.

### **Behavioural risk-taking: context and beverage**

**BART.** A significant main effect of context revealed that risk-taking behaviour was significantly higher when participants were tested within groups rather than in isolation,  $F(1,93) = 3.94, p = .05, \eta_p^2 = .04$  (see figure 3.1). No significant interactions were found ( $p \geq .24$ ). Additionally, no differences were revealed based on block ( $p = .31$ ), and no interactions of context and/or beverage, and block were discovered ( $p \geq .26$ ).

**SLT.** A significant main effect of context revealed that risk-taking was significantly higher among those tested within groups as opposed to those tested in isolation,  $F(1,93) = 7.69, p = .007, \eta_p^2 = .08$  (see figure 3.1). Further, an interaction between time and beverage on SLT performance was found,  $F(1,93) = 4.78, p = .03, \eta_p^2 = .05$ . Simple main effects revealed that participants were significantly less risky on the SLT after consuming a placebo beverage compared to baseline risk-taking,  $F(1,93) = 22.96, p < .001, \eta_p^2 = .20$ . However, there was no significant difference between time one and time two of SLT performance when alcohol was consumed,  $F(1,93) = 2.86, p = .09, \eta_p^2 = .03$ . No interaction between beverage and context was revealed,  $p = .49$ .



*Note.* Mean obtained by averaging pre- and post-beverage scores. Error bars:  $\pm 2$  SE

*Figure 3.1* The effect of context on behavioural risk-taking

## Discussion

Findings from the current study indicate that group contexts increase individual risk-taking behaviour, as predicted. However, against expectations, alcohol consumption and the combined effect of group contexts and alcohol did not increase risk-taking.

Individuals who participated in groups were significantly riskier than those who completed the study in isolation. These findings are consistent with previous work (c.f., Chein et al., 2011; Gardner and Steinberg, 2005; E. K. Reynolds et al., 2013), which indicates that the mere presence of peers increases an individual's risky decisions. It is postulated that the influence of peers on individual risk-taking dissipates with age as young people transition into adulthood (Blakemore & Mills, 2014). However, the current study suggests that the presence of peers can also influence risk-taking behaviour in young adults. This research thereby highlights the importance of considering peer influences when designing interventions to reduce dangerous risky behaviours. To this end, researchers should take caution when generalising lab-based findings in isolated contexts to real-world (social) environments where people may partake in risky behaviours (e.g., night time environments).

In contrast to predictions, the results did not reveal an increase in risk-taking behaviour following alcohol consumption. This contradicts previous research which found an increase in risk-taking following moderate doses of alcohol (Lane et al., 2004; Rose et al., 2014), whilst supporting similar studies suggesting no effect of alcohol (Breslin, Sobell, Cappell, Vakili, & Poulos, 1999; Corazzini, Filippin, & Vanin, 2015). The absence of alcohol-induced risk-taking may be explained by the chosen dose of

alcohol administered within the current study. For example, Lane et al. (2004) revealed dose-dependent effects of alcohol on risky gambling choices across dosages of 0.2, 0.4 and 0.8g/kg. A higher dose of 0.8g/kg may therefore be required to observe pharmacological effects of alcohol on risky behaviours, although other research has found alcohol effects on risk-taking at comparable doses (e.g., 0.6g/kg; Rose et al., 2014). A further explanation for the lack of alcohol effects on the BART and SLT may be based on the sample size used. A power analysis conducted on G\*Power 3.1.9.2, revealed that to detect the effect of alcohol on the BART ( $\eta_p^2 = .007$ ), at an observed power of 0.8, with a significance level of  $p < .05$ , a sample of 1116 would be required. Similarly, the sample size required to detect the effect of alcohol on the SLT ( $\eta_p^2 = .019$ ) at 0.8 power and 5% significance level, is above that of the current study (408 participants required).

An alternative suggestion for the absence of alcohol-elevated risk-taking in the current study could lie with the risk-taking measurements used. No effect of alcohol consumption on risk-taking behaviour was found via the BART (supporting findings from Peacock et al., 2013; B. Reynolds, Richards, & de Wit, 2006), whereas risk-taking via the SLT decreased following only placebo compared to baseline. The SLT findings may suggest compensatory responding within the placebo condition, whereby participants may seek to offset any anticipated alcohol-related declines in performance, therefore positing a psychological (expectancy) effect of perceived alcohol consumption (via placebo). The absence of any change in risk-taking in the alcohol condition may further offer some support towards AMM (Steele & Josephs, 1990) in that, pharmacologically-induced deficits impeding systematic evaluation of behaviour reduces the likelihood of considering anticipated alcohol effects. The varied outcomes of



the BART and SLT could also relate to the extent to which the perception of risk may be socially and morally defined within a given society (Arnoldi, 2009; Green, 1997). From this perspective, risky driving (SLT) may be perceived as dangerous and immoral in comparison to inflating a balloon (BART), which may have led to compensatory responding on the SLT following placebo.

The inconsistencies between the two tasks highlight the importance of attending to specific types of alcohol-induced risky behaviour, both when examining behaviour and when developing protective strategies for alcohol-related risk-taking. However, it is important to note that to my knowledge, the impact of acute intoxication on the SLT has not been investigated to date. Moreover, although previous research has found intoxication effects on the BART (Rose et al., 2014), other null findings in this area could indicate that the BART may lack the sensitivity to detect any effects of acute alcohol consumption (Euser et al., 2011; Peacock et al., 2013; S. C. Reed et al., 2012). The current findings should therefore be interpreted with a degree of caution as the absence of alcohol-induced risk-taking could be a result of the limitations of the task itself. The expansion of the current research to incorporate additional types of risk taking measures is consequently advised.

Finally, against expectations, intoxicated groups did not increase risk-taking above that observed in sober groups, or those tested in isolation. As no interactions between beverage and context were revealed, findings are not in line with previous research, stipulating either a protective (Abrams et al., 2006; Hothrow et al., 2014), or a negative influence (Sayette, Dimoff, et al., 2012; Sayette et al., 2004) of intoxicated groups on risk-taking. However, previous investigations of intoxication effects have

been based on collective group decisions following discussion, rather than on individual decisions in the presence of others (as in the current study). Importantly, decisions made privately in the presence of peers differ from those made collectively as a group both when sober (Centifanti et al., 2016) and intoxicated (Frings et al., 2008). Therefore, these differences may, in part, explain the contrasting findings between the present study and previous work (c.f., Abrams et al., 2006; Hothrow et al., 2014; Sayette, Dimoff, et al., 2012). In the current study, it was requested that participants refrain from discussing the task, however, it is important to note that researchers were not always present to monitor this. For this reason, it is necessary to acknowledge the possibility of task discussion as a limitation of the study. Future research would therefore benefit from comparing collective and individual decisions in group contexts as in Frings et al. (2008), whilst monitoring group communication.

The absence of a combined influence of groups and alcohol on risk-taking potentially offers insight into the dominant factors driving risky behaviours in social drinking environments (e.g., the night time economy; Finney, 2004; Measham and Brain, 2005). Specifically, in support of qualitative work on violence in the night time economy (Levine, Lowe, Best, & Heim, 2012), the current findings also highlight group contexts as being a potentially important factor influencing risky behaviours over and above solely considering the effects of alcohol consumption. Further, as no combined effect of groups and alcohol was revealed, the results suggest that the influence of groups on risky behaviours may not be dependent on alcohol consumption *per se*. These findings therefore highlight the potential importance of considering factors other than alcohol in attempts to reduce risk taking. In other words, interventions may target fruitfully the influence of group contexts (above that of alcohol consumption) to reduce risky behaviours in social drinking settings. Nonetheless, future research would benefit

from the exploration of potential interactions between group contexts and alcohol consumption utilising a broader range of risk-taking measures.

It is necessary to note potential methodological limitations in the current study. First, the present investigation utilised only a placebo and an alcohol condition. As such, it may be that findings from the current placebo condition are reflective of alcohol expectancies (Martin & Sayette, 1993). Indeed, the mere presence of alcohol-related olfactory cues (as would be the case in the current placebo condition) has been shown to hinder participants' ability to inhibit their behaviour (Monk, Sunley, Qureshi, & Heim, 2016). Future research may therefore benefit from the additional inclusion of a pure control group (for example, the use of a soft drink where there is no suggestion of alcohol consumption). Nonetheless, previous research (c.f., Abrams et al., 2006) found that alcohol increases risk-taking, relative to a placebo. Furthermore, the present paradigm included a repeated element to examine baseline (sober) measures of risk-taking, which allowed risk-taking comparison between sober, intoxicated (alcohol) and perceived intoxication (placebo). The current findings should therefore be viewed a first step, informing future investigation in this area. A further consideration regarding the alcohol administration procedure, concerns the time of risk-taking measurement; risky behaviour was examined on the ascending limb of the blood alcohol curve (BAC), similar to many previous studies (Berthelon & Gineyt, 2014; Lane et al., 2004; Rose et al., 2014). However, as research points to a higher propensity for risk-taking on the descending limb of the BAC (Bidwell et al., 2013), future research could benefit from examining social and alcohol influences on risk-taking across both the ascending and descending BAC limb.

Second, the original BART (Lejuez et al., 2002) measures ‘adjusted average pumps’ and analyses therefore exclude trials when the balloon explodes. This is due to the inability to infer how risky a participant would have been on those trials, if the balloon had not exploded. Future research may therefore benefit from utilising the automated version of the BART (c.f., Pleskac, Wallsten, Wang, & Lejuez, 2008), which records participants’ intended number of pumps and is able to provide data on risk-taking behaviour across all trials. Furthermore, both risk-taking tasks in the current study offered no real incentives (e.g., monetary rewards) for task completion. As previous research suggests that participants will evidence stronger loss aversion (less risk) when there are monetary versus hypothetical incentives (Xu et al., 2016), future studies should consider the inclusion of more ecological rewards.

Finally, it is important to consider the recruitment of natural friendship groups over previously unacquainted groups. The use of friendship groups presents the possibility of pre-existing group norms for that specific group, which may therefore influence the groups behaviour in line with these normative beliefs (Berkowitz, 2004). Previous research has adopted unacquainted peers with the intention (in some cases) to control for pre-existing group norms (Kuendig & Kuntsche, 2012). However, the choice to recruit natural friendship groups in the current study was in line with intentions to replicate a more natural social drinking context where alcohol would commonly be consumed with familiar peers. In real world situations, normative beliefs reside and therefore rather than removing the possibility of such influences, future research would benefit from considering these effects alongside other factors (e.g., intoxication level and context). Furthermore, to fully delineate the role of groups on risky behaviour in social settings, it would be beneficial to establish such influences across a variety of groups, such as unacquainted versus natural groups.

Through examining the influence of social contexts and alcohol consumption on individual risk-taking, the study found that group contexts increased risk-taking behaviour regardless of alcohol consumption. Current findings suggest that targeting the influence of groups (above that of alcohol), could be a way of inducing positive outcomes when addressing risky behaviour in social drinking contexts. Moving forward, expanding investigations into different types of risk-taking (using varying behavioural measures) and group influence (measuring collective and individual members risk-taking) may aid in the development of more targeted interventions.

### **Chapter Conclusions**

Chapter 3 investigates the role of alcohol consumption as a determinant of risky behaviour, opposed to the previous chapter exploring alcohol use as a consequence of risky personality characteristics. Utilising an experimental alcohol administration paradigm, Study 2 investigated the effects of both alcohol (0.6g/kg) and group versus isolated contexts on risky behaviour. More specifically, this chapter investigated both a domain specific measure of risk (risking driving) and a general measure (BART). Through using such methods, the chapter concludes that group contexts consistently increase risky behaviour (both general and domain-specific), regardless of alcohol consumption. Against predictions, alcohol did not influence risk-taking. However, when measuring a domain-specific risk behaviour, alcohol consumption inhibited evaluation of previous behaviour and as such risk-taking was reduced only after placebo when completing the driving task for the second time. Findings in the current chapter directly feed into the measures and procedures utilised in the following chapter. Namely, the current study recommends an increase in alcohol dose to determine alcohol effects on

risky behaviour, and the use of more ecologically valid measures of risk-taking behaviour to enhance generalisability to real world behaviours.

## Chapter 4 Study 3

### Abstract

**Background:** Research addressing the combined influence of social factors and alcohol on risky behaviour present contrasting findings, which could partly be due to the variety of measurements used, and further influences of mood. Using a novel, ecologically valid risk-taking measure the study aimed to examine the influence of intoxication and peer presence on individual risk-taking, and the possible mediating effects of mood.

**Method:** In a between participants design, 132 social drinkers (83 female) completed an experimental session individually ( $N = 66$ ) or in the presence of two friends ( $N = 66$ ).

Participants consumed an alcoholic (0.8g/kg) or placebo beverage (groups all consumed the same drink). Risk-taking was then assessed via the shuffleboard game; sliding a

bottle along a table to gain points, with points deducted for sliding off the edge. Mood was assessed before and after beverage consumption. **Results:** The presence of peers

and alcohol consumption independently increased risk-taking. However, there was no interaction between beverage and testing context. The presence of peers increased

positive mood, whereas alcohol did not seem to influence affective state. Findings

further suggest that mood significantly predicted risk-taking, however it did not mediate the relationship between peer presence and risk-taking. **Conclusion:** Intoxication and

peer presence seemingly influence risk-taking behaviour independently, however the combination of both alcohol and social contexts does not heighten this effect further. It

may therefore be beneficial to target these factors separately to maximise intervention potential for reducing risky behaviours in social drinking environments. Furthermore,

mood appears to affect risk-taking behaviour, highlighting the importance of

considering affective state when investigating risky behaviours.

## Introduction

The link between alcohol consumption and increased risk-taking behaviour has been well documented (Lane et al., 2004; Rose et al., 2014). However, most experimental alcohol research focuses on behaviours in isolated laboratory contexts, often neglecting possible contributing social and affective factors which typically accompany drinking in real world environments. Moreover, existing studies examining how group contexts and intoxication impact risk-taking behaviours yield inconsistent findings (Abrams et al., 2006; Erskine-Shaw, Monk, Qureshi, & Heim, 2017; Sayette, Dimoff, et al., 2012) and use tasks which, to a greater or lesser extent, bear little resemblance to real life risk-taking while intoxicated. In view of the suggestion that strategies for targeting alcohol-related behaviours are more likely to be effective if they are sensitive to contextual and affective influences in real-life drinking environments (Monk & Heim, 2013b), further research is needed to unpick the pharmacological and social factors shaping risk-taking.

Research to date examining the combined impact of groups and intoxication on risky behaviour, presents variable findings. For example, Sayette, Dimoff, et al. (2012) found an increase in risk-taking behaviour in intoxicated groups relative to sober groups and intoxicated individuals. Abrams et al., (2006), on the other hand, found a protective effect of groups whereby alcohol-induced increases in risky behaviour was only found in individuals tested in isolation. In contrast, group risk-taking did not differ following alcohol consumption. Adding to the inconsistent findings, participants tested in the presence of peers appear riskier than those tested in isolation regardless of beverage consumed (Erskine-Shaw et al., 2017). Overall, it seems likely that the discrepant



findings which are found in this area of research may be due to methodological differences regarding risk measurement in different studies.

As such, researchers have used a repertoire of risk-taking measurements which include computerised lab tasks such as the balloon analogue risk task (Lejuez et al., 2002; Rose et al., 2014), self-report measures of trait risk-taking (de Haan et al., 2011), choice dilemmas (Hopthrow et al., 2014; Kogan & Wallach, 1964), and gambling tasks (Abrams et al., 2006). These experimental paradigms have been a valuable means for researchers to unpick, in controlled settings and with ethical constraints in mind, the extent to which alcohol and variable social contexts interact to shape risk-taking behaviour. However, the risk-taking tasks used to date have tended to be hypothetical and/or reliant on participants to self-assess risky behaviour. Therefore, it would appear prudent for researchers to develop more ecologically valid means of measuring alcohol-related risk taking.

A further issue for risk-related alcohol research relates to the multifaceted nature of 'risk-taking' encompassing both (i) deliberate and reflective decision-making as well as (ii) impulsive risk-taking (Heinz et al., 2011). In some research, trait impulsivity appears to be positively related to behavioural measures of risk-taking (Lauriola et al., 2014; Lejuez et al., 2002), while other studies find negligible associations in that regard (Stamates & Lau-Barraco, 2017). Differences in risk-taking tasks in the extent to which they entail deliberate or impulsive decisions may therefore be a reason for observed inconsistencies. For example, risk-taking which is carried out in unplanned situations requiring rapid responses may be more likely to be associated with impulsive traits (c.f., Stanford et al., 2009). When examining the impact of intoxication on risk-taking, it is

therefore worthwhile to establish its association with trait measures of both impulsivity and general risk-taking.

Researchers interested in examining how different social contexts interact with alcohol consumption to shape risk-taking behaviours should account for the influence of affective states on risk-taking. This is because alcohol consumption is a well-known regulator of emotions (Fairbairn & Sayette, 2014; Lowe et al., 2013; Sayette, 2017; Sayette, Creswell, et al., 2012) and mood can be altered via social influences (Neumann & Strack, 2000; Parkinson & Simons, 2009; Sy, Côté, & Saavedra, 2005). Moreover, there is a growing body of evidence to suggest that risk-taking is shaped by the mood people are in (Kim & Kanfer, 2009; Yuen & Lee, 2003). Together these lines of enquiry highlight the possibility that the relationship between social drinking and risk-taking behaviour may to some extent be mediated by mood.

Theoretically alcohol-induced risk-taking is often explained by an impaired ability and/or motivation to weigh up fully possible behavioural and cognitive consequences while intoxicated (Steele & Josephs, 1988). Therefore, these accounts, to a degree, assume risks are evaluated analytically based on probabilities of reward and consequence. However, dual process models of risk-taking behaviour offer some explanation of the way in which risk-taking may be associated with both ‘cold’ (analytical) and ‘hot’ (affective states) processes (Heinz et al., 2011; van Gelder et al., 2009). Negative affective states, for example, appear to increase propensity for risk-taking (Kim & Kanfer, 2009; Yuen & Lee, 2003). Further, the emotional valence and expected outcome of a risky situation (e.g., analytical versus affective, gain versus loss) appear to influence risky choices (Druckman & McDermott, 2008; van Gelder et al.,

2009). Consideration of affective states therefore appears to be an important when examining the impact of alcohol consumption on risky behaviour.

With the above in mind, the aim of the current study is to examine in a more ecologically valid manner than previous research, the impact of intoxication, peer presence and affective states on risk-taking behaviour. It is hypothesised that social drinking will increase risk-taking behaviour to a greater degree than drinking in isolation and placebo consumption, and that this will be mediated by participant mood.

## Method

### Design

The study used a 2 (Beverage: Alcohol vs. Placebo) x 2 (Context: Isolation vs. Groups) between participants design.

### Participants

Social drinkers ( $N = 132$ ) were recruited individually ( $N = 66$ ) and as part of natural friendship groups of three ( $N = 66$ ), via opportunity sampling at a UK university<sup>9</sup>. Participants had a mean age of 20 years ( $SD = 2.34$ ), and 63% were female ( $N = 83$ ). Prior to the experimental session, participants were required to complete a medical screening to confirm that they were in good health, were not on any medication which could interact with alcohol, and had no history of alcohol-related issues. It was required that participants must drink alcohol at least once per week and not be currently attempting to cut down their consumption. Comparable to Study 2 (Chapter 3), the gender make-up of groups was recorded. The proportion of varied group gender compositions did not differ between alcohol and placebo conditions ( $p = .12$ , Fisher's exact test). However, no all-male groups were tested in the placebo condition, whereas 36% of the groups consuming alcohol comprised of only males. In both conditions, there was a higher proportion of all-female groups (alcohol = 36%, placebo = 55%) than mixed-gender groups (alcohol = 27%, placebo = 45%).

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<sup>9</sup> An a priori power analysis conducted using G\*Power 3.1.9.2 revealed a minimum of 120 participants to achieve a power of .80

## **Materials and measures**

**Beverage administration.** In a single-blind design, participants were randomly allocated to consume 0.8g/kg of alcohol, or a placebo beverage. The alcohol condition consisted of vodka together with equal amounts of orange juice and tonic water. The placebo beverages contained equal amounts of concentrated orange juice and tonic water, to match the volume which would be given in the alcohol condition. Before consumption, participants were given a strong-tasting lozenge (Fisherman's Friend) to mask the taste of the beverages. Further, to enhance perception of alcohol consumption, vodka mist was sprayed on the surface of the placebo drink, and onto the rim of the glass. For each condition, the beverages were separated across three glasses, which were consumed across 10 minutes. Alcohol administration procedures were adapted from previous studies (Abrams et al., 2006; Rose & Duka, 2006; Rose et al., 2014).

## **Questionnaires**

***Alcohol Use Disorder Identification Test.*** (AUDIT; Saunders, Aasland, Babor, De La Fuente, & Grant, 1993). The AUDIT was found to have a high internal consistency in the current sample (Cronbach's  $\alpha = .76$ ).

***Barratt Impulsivity Scale*** (BIS-11; Patton et al., 1995). The total BIS-11 score, and non-planning subscale showed high internal consistency (Cronbach's  $\alpha > .73$ ), whereas the attentional (Cronbach's  $\alpha = .62$ ) and motor impulsivity (Cronbach's  $\alpha = .58$ ) subscales had low to acceptable consistency.

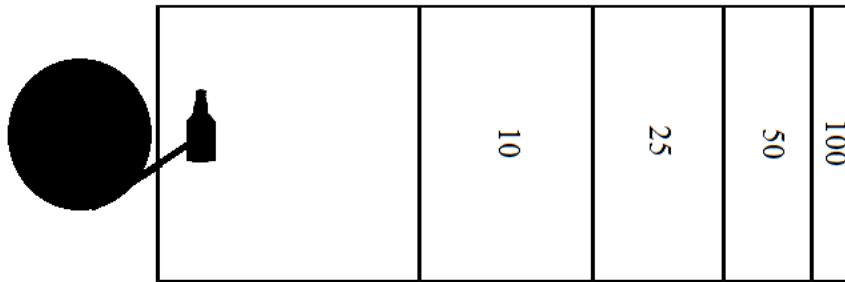
**RT-18** (de Haan et al., 2011). All subscales and total RT-18 score had high internal consistency (all Cronbach's  $\alpha > .72$ ).

**Mood and Subjective Intoxication Questionnaire:** The questionnaire consists of 10 visual analogue scales measuring 100mm, with anchors of 'not at all' and 'extremely'. The subjective intoxication scale in Chapter 2 was combined with six mood statements (three positive and three negative affective states (e.g., 'happy' and 'sad')). Participants were required to state how they currently felt along the VAS, in relation to each statement. Subjective intoxication and mood were assessed separately. Mood was calculated by reversing scores on negative affective states and subsequently calculating the sum of VAS's measuring mood. Both scales showed high internal consistency before and following alcohol and placebo (all Cronbach's  $\alpha > .76$ ).

### **Risk-taking task**

**The Shuffleboard Game:** An adapted version of the shuffleboard game was developed to measure physical risk-taking behaviour (see figure 4.1). Previous versions (Kogan & Wallach, 1964; Miller & Byrnes, 1997) have involved sliding a coin along a shuffleboard table whilst avoiding touching markers on either side of the table, which vary in width. In this modified version participants slide an empty beer bottle along a 240cm table with an aim to land in one of four scoring zones (divided by straight lines across the width of the table). The length of the scoring zones decreases, as the rewarded points increase: 10 points between 90-150cm (60cm zone), 20 points between 150-195cm (45cm zone), 50 points between 195-225cm (30cm zone), and 100 points between 225-240cm (15cm zone). If the bottle slides through the 100-point zone, and off the table there is a penalty of -25 points. Each participant completes one practice trial, and three test trials with the objective to score as many points as possible. Risk-

taking is measured by the average distance of the bottle slide across test trials, with a larger distance indicating higher risk-taking. In the case of a penalty, 25cm is added to the total length of the board (equalling 265cm).



*Figure 4.1* A diagrammatic representation of the Shuffleboard Game.

### **Procedure**

All materials and procedures were ethically approved via the university's research ethics committee (see Chapter 3 for ethical considerations). Participants attended the psychology department either individually or in a group of three for a single experimental session between 12:00-19:00, Monday-Friday. Participants were requested to avoid alcohol for 12 hours, and eating for three hours prior to the session, and on arrival were breathalysed to confirm no traces of alcohol. Those who participated as a group were required to complete all questionnaire and tasks individually but were permitted to communicate throughout and were asked to not discuss the study.

Participants started by completing the BIS-11, RT-18, and mood and subjective intoxication questionnaire. Those who participated in groups were also required to

complete a further two questions to confirm their relationship and social drinking habits with the other groups members. Following this, participants were allocated randomly to consume either alcohol or placebo (all group members consumed the same beverage type) before resting for 20 minutes to ensure testing on the ascending limb of the blood alcohol curve (Rose & Duka, 2006). Participants were then breathalysed and asked to complete a second set of the mood and subjective intoxication questionnaire, before proceeding onto the shuffleboard game. Finally, participants were debriefed and breathalysed. For BrAC scores above 0.14mg/l participants were asked to stay within the laboratory. Those who expressed a need to leave were required to sign a disclaimer.



## Results

### Participant characteristics

Participant's trait risk-taking, alcohol consumption behaviour, and baseline mood did not differ across conditions of beverage or context ( $p$ 's > .09). All participants who were tested in groups ( $N = 66$ ) confirmed friendship with their group members. Of these participants, 65% reported drinking with each other often, 27% occasionally, and the remaining 8% claimed that they never consumed alcohol with their group members. See Table 4.1 for descriptive statistics.

### Breath alcohol concentration and subjective intoxication

The average breath alcohol concentration (BrAC) 20 minutes following consumption was 0.44 mg/l ( $SD = .14$ ). A 2 (Beverage: Alcohol vs. Placebo) x 2 (Time: Baseline vs. Post-Beverage) mixed ANOVA, and simple main effects analysis was used to examine subjective intoxication. A main effect of time was revealed,  $F(1,130) = 213.90, p < .001, \eta_p^2 = .62$ . Participants felt significantly more intoxicated following alcohol ( $M = 215.09, SD = 82.87$ ), compared to baseline ( $M = 67.79, SD = 48.41$ ),  $F(1,130) = 247.19, p < .001, \eta_p^2 = .67$ . Placebo manipulation was found to be successful as participants scored significantly higher on feelings of intoxication 20 minutes' post consumption ( $M = 112.27, SD = 66.67$ ), compared to baseline ( $M = 65.79, SD = 42.06$ ),  $F(1,130) = 24.61, p < .001, \eta_p^2 = .12$ . An interaction of beverage and time was also found,  $F(1, 130) = 57.90, p < .001, \eta_p^2 = .31$ . Simple main effects revealed that, subjective intoxication was significantly higher post-consumption in the alcohol condition compared to placebo,  $F(1,130) = 61.69, p < .001, \eta_p^2 = .32$ .

Table 4.1

*Descriptive statistics by context and beverage (means and standard deviations)*

Variables	Individual		Group	
	Alcohol ( <i>N</i> = 33) <i>M</i> ( <i>SD</i> )	Placebo ( <i>N</i> = 33) <i>M</i> ( <i>SD</i> )	Alcohol ( <i>N</i> = 33) <i>M</i> ( <i>SD</i> )	Placebo ( <i>N</i> = 33) <i>M</i> ( <i>SD</i> )
Age	20.88 (3.61)	20.12 (2.19)	19.23 (1.02)	19.45 (1.23)
AUDIT	11.27 (4.89)	11.64 (5.99)	12.97 (5.10)	13.09 (5.14)
BIS-11	64.87 (9.68)	67.46 (8.38)	68.42 (10.64)	68.89 (8.48)
RT18	9.27 (3.51)	10.04 (4.62)	9.36 (4.53)	10.46 (4.00)
Mood (t1)*	457.61 (72.91)	438.15 (92.29)	449.45 (74.31)	420.73 (86.56)
Mood (t2)*	497.50 (76.18)	455.91 (92.39)	528.76 (53.15)	481.54 (90.12)
Shuffleboard	197.98 (31.74)	186.94 (24.65)	209.46 (30.82)	195.21 (25.50)

*Note.* \*t1 refers to baseline, t2 refers to 20 minutes post-beverage

### **Risk-taking**

**Trait impulsivity and risk-taking:** A correlational analysis was conducted to examine relationships between trait risk-taking (RT-18) and impulsivity (BIS-11), and behavioural risk-taking via the shuffleboard game. Trait impulsivity was positively correlated with behavioural risk-taking,  $r = .25$ ,  $p = .005$ , whereas trait risk-taking revealed no significant relationship with shuffleboard risk-taking,  $r = .06$ ,  $p = .49$ .

Further correlations were conducted on BIS-11 subscales of impulsivity (Bonferroni adjusted  $p$ -value of .017), and the RT-18 subscales of risk-taking (Bonferroni adjusted  $p$ -value of .025) on the shuffleboard game. A significant correlation was only revealed with attentional impulsivity,  $r = .22$ ,  $p = .01$ , and non-planning impulsivity,  $r = .22$ ,  $p =$

.01. All other BIS-11 and RT-18 subscale correlations with behavioural risk-taking were insignificant,  $ps > .29$  (see Table 4.2 for all correlations).

Table 4.2

*Correlation matrix for trait impulsivity (BIS-11) and risk-taking (RT18), and the shuffleboard game*

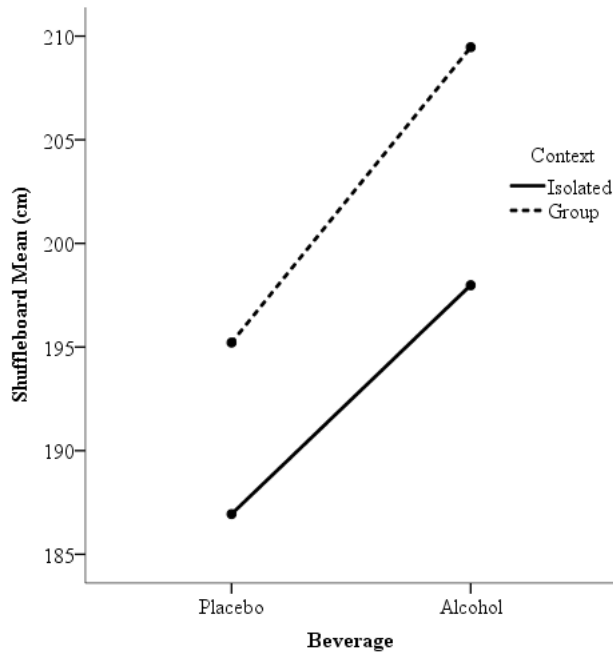
Measure	1	2	3	4	5	6	7	8
1. Shuffleboard	--							
2. BIS-11	.25*	--						
3. - Attentional	.22*	.67**	--					
4. – Motor	.09	.73**	.28**	--				
5. - Non-Planning	.22*	.83*	.39**	.43**	--			
6. RT-18	.06	.53**	.28**	.50**	.47**	--		
7. - Behaviour	.02	.27*	.20*	.26*	.21*	.85**	--	
8. - Assessment	.09	.63**	.28**	.58**	.58**	.82**	.38**	--

\* $p < .05$ , \*\* $p < .001$

**Context and beverage:** A 2 (Beverage) x 2 (Context) ANOVA examined risk-taking behaviour on the shuffleboard game. Analysis revealed a significant main effect of beverage on risk-taking, as participants were significantly riskier following alcohol consumption, opposed to placebo,  $F(1,128) = 6.57, p = .01, \eta_p^2 = .05$ . A main effect of context found that participants who were tested in the presence of peers were

significantly riskier than those tested in isolation,  $F(1,128) = 4.00, p = .05, \eta_p^2 = .03$ .

There was no interaction of beverage and context on risk-taking behaviour,  $F(1,127) = .03, p = .87$  (see Figure 4.2).



*Figure 4.2* Risk-taking behaviour following alcohol and placebo consumption, in isolation and peer presence contexts

In the peer presence condition, participants were able to view the performance of others in their group, as members took turns to play each of their trials, opposed to one individual playing all trials consecutively. Therefore, an additional 2 (Beverage) x 2 (Context) ANOVA was conducted on only the final shuffleboard trial, to detect risk-taking at the point at which individuals will have viewed their peer's performance.

Neither context or beverage was found to have a significant effect on risk-taking via the final shuffleboard trial: beverage  $F(1,128) = .50, p = .48, \eta_p^2 = .004$ , context  $F(1,128) =$

.42,  $p = .52$ ,  $\eta_p^2 = .003$ . The findings suggest that the effects of peer presence on risk-taking behaviour may not be reliant on observing the behaviour of others.

### **Mediating effects of mood on alcohol-induced risk-taking**

**Context, beverage and mood:** A 2 (Beverage) x 2 (Context) ANOVA was performed on mood to examine the impact of beverage type and testing context on mood change (score obtained by subtracting baseline from post-consumption score). A positive score indicates an increase in positive mood. Analysis revealed a main effect of context, mood change increased significantly in the presence of peers, compared to those in isolation  $F(1,128) = 13.33$ ,  $p < .001$ ,  $\eta_p^2 = .09$ . No effect of beverage, and no interactions between context and beverage was found on mood change,  $ps > .07$ .

**Mood and risk-taking:** A simple linear regression was then performed to examine whether mood change predicts risk-taking on the shuffleboard game, which was not separated by conditions. Results indicated that mood predicted a significant amount of variance in risk-taking behaviour,  $F(1,130) = 5.75$ ,  $p = .02$ ,  $R^2 = .04$ ,  $\beta = .21$ . Therefore, elevated levels of mood predicted higher risk-taking.

**Mediation:** Mediation analysis was performed to examine whether the effect of peers (opposed to those in isolation) on risk-taking behaviour was mediated by mood change (from baseline to post-beverage) using the PROCESS macro (version 2.6) for IBM SPSS Statistics 24 (Hayes, 2013). However, as no beverage effect was found on mood, the beverage variable was not included in mediation analysis. Analysis revealed peer presence marginally predicted an increase in risk-taking behaviour  $\beta = 9.88$ ,  $t(130)$

= 1.97,  $p = .051$ , 95% CI [-.06, 19.81]. Peer presence was further found to significantly predict increased positive mood change,  $\beta = 41.23$ ,  $t(130) = 3.63$ ,  $p < .004$ , 95% CI [18.78, 63.680], and an indirect effect was demonstrated  $F(2,129) = 3.76$ ,  $p = .03$ ,  $R^2 = .06$ , as mood change marginally predicted risk-taking  $\beta = .07$ ,  $t(129) = 1.89$ ,  $p = .06$ , 95% CI [-.003, .15]. Further, when mood change was accounted for, the variance in risk-taking behaviour from context was reduced  $\beta = 6.88$ ,  $t(129) = 1.32$ ,  $p = .19$ , 95% CI [-3.45, 17.21]. As some effects were marginal, the overall indirect effects of context on risk-taking through mood change was not revealed,  $\beta = 3.00$ , 95% CI [-.04, 7.87].

## Discussion

Using a novel measure of risk-taking, the current study investigated the influence of alcohol and peer presence on risk-taking behaviour and the possible mediating effects of mood. Results point to an increase of risk-taking behaviour following alcohol consumption compared to placebo and when tested in the presence of peers, as opposed to in isolation. However, no interaction between alcohol and peer presence was found, suggesting that the presence of peers does not magnify the effect of intoxication on risky behaviour. Findings suggest further that positive mood change (from baseline to post-beverage) was significantly higher when tested with peers. However, contrary to predictions, alcohol consumption did not enhance mood, and mood change did not mediate the relationship between peer presence and risk-taking behaviour.

The increase of risk-taking behaviour following alcohol consumption is consistent with much of the experimental literature examining alcohol and risky behaviour in isolated, lab-based contexts (Lane et al., 2004; Rose et al., 2014). By examining alcohol-induced risk-taking in the presence of peers and using a novel measure of risk taking, the current study both supports and enhances the generalisability of these previous findings. Further, in support of the general risk-taking literature often using computerised tasks (c.f. Blakemore & Robbins, 2012; Centifanti et al., 2016), in the current study risk-taking behaviour was found to be elevated in the presence of peers in comparison to testing in isolation, regardless of beverage-type. The current study therefore adds weight to the assertion that researchers need to consider the extent to which risk-taking in isolated, lab-based contexts is able to capture risk-taking in social environments. Analyses of the final trial of the shuffleboard task provide further

insights here. This analysis was designed to assess peer performance when all participants had the opportunity to observe all their peers, as participants were able to view the performance of others in their group (as members took turns to play each of their trials, opposed to one individual playing all trials consecutively). Here, it is possible that the absence of any contexts effects may suggest that peer imitation is not the driver of the observed effect of group context. In other words, peers do not seek to imitate their peers' performance. Alternatively, this may suggest that as participants become more experienced on the task, they may be less affected by the presence of others. This may have implications for our understanding of the effect of groups and alcohol on risk when one considers the potential effects of typical as opposed to novel risky situations.

With notable exceptions (Abrams et al., 2006; Erskine-Shaw et al., 2017; Hothrow et al., 2014; Sayette, Dimoff, et al., 2012), the influence of peers on risk-taking behaviour has rarely been investigated in intoxicated individuals in group settings. This previous work has found that intoxicated groups collectively make either riskier (Sayette, Dimoff, et al., 2012) or safer (Abrams et al., 2006; Hothrow et al., 2014) choices, in comparison to intoxicated individuals. Also adding to more recent work in this area (Erskine-Shaw et al, 2017), the current study extends this body of work to the investigation of group influence on individual risk-taking (opposed to a collective group decision). The current findings suggest that both intoxication and peer presence independently increase risky behaviour, but that these two factors do not interact with each other to further heighten risk-taking. The lack of an interaction between intoxication and peer presence highlights the possible need to address these influences independently. From this perspective, the effectiveness of solely targeting alcohol consumption in an attempt to reduce risky behaviours may be undermined as a result of residing influences of social presence in drinking settings. Intervention efforts



in alcohol contexts may therefore benefit from targeting both social influences and alcohol consumption in the development of holistically effective safeguarding practices to risk-taking.

In line with previous literature (Neumann & Strack, 2000; Parkinson & Simons, 2009; Sy et al., 2005) being in the presence of peers significantly influenced participants' mood in the current study. However, contrary to predictions derived from existing work (c.f., Sayette, 2017) alcohol consumption did not increase mood to a greater extent than consuming the placebo beverage. This unexpected finding may have been the result of the increase of subjective intoxication following the placebo beverage (as manipulation checks indicated). It would therefore appear advisable for future alcohol research in this area to include a pure control beverage to enable comparison of both anticipated and pharmacological effects of alcohol in relation to a non-alcohol condition (actual and anticipated) (c.f., Christiansen, Jennings, & Rose, 2016; Christiansen, Townsend, Knibb, & Field, 2017).

Interestingly, in the current study mood change significantly predicted risk-taking behaviour. This supports the notion that risk-taking is, in part, influenced by both 'hot' (emotional) states, and 'cold' (analytical) processes (Heinz et al., 2011; van Gelder et al., 2009). Our results suggest that both peer presence and mood were independently-related to risk taking, and that mood itself predicted risk-taking behaviour. However, these variables did not interact in a way to suggest that the effect of peers on risk-taking was mediated by mood. Contrary to previous research (Kim & Kanfer, 2009; Yuen & Lee, 2003) the current study suggests enhancement of mood increases risk-taking behaviour. However, opposing findings are based on research examining risk-

taking via questionnaires based on choice dilemmas with studies either in isolated or group contexts (not within the same study), differing from the methodology used in the current study. Future research is therefore advised to examine more systematically, and using a greater variety of measures, the extent to which mood influences on risk-taking may be task and context dependent.

Finally, with regards to the aim of developing a measure of risk-taking behaviour more akin to real world risk-taking in drinking settings, the shuffleboard game examined physical risk-taking behaviour, opposed to commonly used choice dilemma questionnaires (Hopthrow et al., 2014), or computerised tasks (Erskine-Shaw et al., 2017). Physical-types of the risk-taking behaviour such as risky drinking games (Zamboanga et al., 2014) are often associated with social drinking environments in the real world. The risk-taking measure designed for the current study brings an element of this type of risk-taking by adopting a physical component to form an attractive game for young adults. The shuffleboard game illustrated a sensitivity to an acute dose of alcohol and to the presence of peers. Interestingly, analysis found a positive association between impulsivity which has also been demonstrated with various other risk-taking measures (Lauriola et al., 2014; Lejuez et al., 2002). It is therefore reasonable to suggest that the risk-taking type measured by the shuffleboard game appears more akin to measures of impulsive as opposed to deliberate thought-out risk-taking, and findings should be interpreted with this in mind.

A number of limitations needs to be borne in mind when considering the current findings. Firstly, the current study did not include a pure control beverage condition, when participants are aware that they are not consuming alcohol. The anticipated effects

of alcohol from a placebo appear to increase alcohol craving and further alcohol consumption above that of a pure control (Christiansen et al., 2017). It may therefore be that a lack of alcohol effect on mood change is in part due to the anticipated effects of alcohol. Future investigations would benefit from an additional pure control condition to unpick both anticipated and pharmacological effects of alcohol.

It is important also to note limitations with the shuffleboard game itself. This measure of physical risk-taking requires some motor skill and co-ordination to slide the bottle in a straight line, to avoid it falling off the sides of the table. As alcohol appears to impair motor control (Houa et al., 2010; Marczinski et al., 2012), it is necessary to consider a possible contributing factor of weakened motor coordination to shuffleboard results. However, in the current study all participants could direct the bottle in a straight line along the table (the bottle did not fall off the sides), therefore suggesting that motor coordination was not severely impaired. A further measure of motor coordination to compare with shuffleboard findings, may aid in understanding the full extent of behaviours in which the shuffleboard may, or may not measure. Moreover, the impact of social contexts on self-reported confidence on motor-skilled tasks (Frings et al., 2017), may influence shuffleboard game risk-taking. Therefore, consideration of task confidence may prove fruitful in unpicking further influencers on the shuffleboard game, and possible mediating effects on the relationship between social drinking and risk-taking.

Finally, as noted in Study 2 (Chapter 3), group recruitment procedures of the current study expose potential influences from pre-existing group norms (Kuendig & Kuntsche, 2012), due to the recruitment of natural friendship groups opposed to

unacquainted peers. The current study utilised natural groups in order to replicate a more natural drinking environment, where alcohol is usually consumed with friends. However, rather than removing the potential of such effects (at the expense of reducing external validity), future research would benefit from considering the impact of pre-existing norms on natural groups. Further, examination of natural versus unacquainted groups may prove fruitful in elucidating the role of social influences.

In conclusion, the current research suggests that both intoxication and the presence of peers independently increase risk-taking behaviour. However, results indicate that the combination of both intoxication and peer presence does not amplify risky behaviour further. It may therefore be prudent for researchers aiming to improve intervention efforts to account for effects of each of these two significant influencers on risk-taking separately. By indicating that positive mood was associated with higher risk-taking, the present findings point to the importance of accounting for both ‘hot’ affective states, in addition to ‘cold’ analytical processes when considering factors impacting risk-taking behaviour. It is also advised that behavioural research in this area should investigate more systematically possible context and task effects when examining how affective states impact risk-taking. Finally, the development of a novel risk-taking measure that is possibly more akin to drinking behaviours in the real world, contributes to the methodological repertoire for researchers in this area.

## Chapter Conclusions

The aims of the Chapter 4 were to investigate the independent and combined effects of an increased dose of alcohol consumption (0.8g/kg) and group versus isolated contexts of risky behaviour, more akin to real world drinking environments. For the current study a novel measure of risk-taking (The Shuffleboard Game) was developed to mimic drinking games which are currently in place in bars around the UK (c.f., <https://shufl.co.uk/>). The chapter concluded an independent effect of both group contexts and alcohol consumption on risk-taking (via The Shuffleboard Game) although no interaction between the two. The chapter illustrates some important considerations for both future research and intervention, suggesting more focused consideration on the role of both social influences and alcohol use when targeting or investigating alcohol-related behaviours presented in social environments. The findings build on the previous chapter as a higher dose of alcohol (more representative of a binge episode) resulted in increased risk-taking, whereas previous findings (albeit with varying measures of risk) did not find comparable effects with a smaller alcohol dose. Further, the study contributes findings in relation to physical risk-taking, more akin to real world drinking games. The following chapter details a study conducted in line with the thesis aims to examine alcohol-related risk-taking in contexts more representative of alcohol consumption. More specifically, the subsequent study investigated the association between intoxication and risk-taking behaviour across natural alcohol and non-alcohol related social environments.

## Chapter 5 Study 4

### Abstract

**Background:** Field research in natural drinking environments suggests that intoxication is negatively associated with risky behaviour, conflicting with many lab-based findings.

Inconsistencies may, in part, be explained by the influencing environmental and contextual differences between such studies. This study therefore aimed to investigate the effects of intoxication and injunctive norms on risk-taking behaviour in alcohol and non-alcohol related environments. **Method:** Participants were recruited in non-alcohol (university communal space,  $N = 71$ ) and alcohol-related (student union bar,  $N = 67$ ) environments, and subsequently were breathalysed to measure intoxication. The size of each social group was recorded in addition to self-reported alcohol use, trait risk-taking, experience of alcohol-related risky consequences, and perceived peer approval of such consequences (injunctive norms). Participants individually chose from a number of lotteries varying in risk level. **Results:** Lottery risk-taking was not influenced by environment, intoxication or injunctive norms. However, increasing group size predicted riskier lottery choices in non-alcohol-related environments only. Further, alcohol-related injunctive norms were perceived as riskier when tested in the bar, compared to the communal space. Injunctive norms predicted experience of alcohol-related risky consequences. **Conclusions:** When in social settings, alcohol (both cued and consumed) does not influence risky behaviour. This possibly suggests that in real world environments social groups may overwhelm such alcohol-induced effects on risk-taking behaviour found in some laboratory studies. Findings further point to the importance of (contextually-dependent) perceived injunctive norms on individual's engagement in alcohol-related risk. Targeting such perceptions may aid intervention efforts aiming to reduce harmful drinking behaviour.

## Introduction

The influence of alcohol has frequently been found to heighten risk-taking in experimental research (Burian et al., 2002; Lane et al., 2004; Veldstra et al., 2012). However, the association between alcohol and risky behaviour has rarely been tested in real world drinking environments. To address such shortcoming, there have been attempts to complement knowledge gained from controlled laboratory studies, through experimental field work providing higher external validity (G. W. Harrison & List, 2004; Proestakis et al., 2013). However, those who have explored the relationship between alcohol and risky behaviour in real drinking environments have revealed varied findings (e.g., Hothrow et al., 2014; Lyvers et al., 2011; Lyvers et al., 2015; Proestakis et al., 2013), which at times show inconsistencies with laboratory based work (Burian et al., 2002; Lane et al., 2004).

Alcohol is postulated to impair behavioural inhibition and narrow attention, impeding systematic evaluation and consequently increasing risk-taking. Indeed, there is a plethora of laboratory based research supporting the effect of intoxication on increased risk-taking (Gilman, Smith, Ramchandani, Momenan, & Hommer, 2012; Laude & Fillmore, 2016; Rose et al., 2014). Further, this effect is suggested to be linear, finding dose dependent effects of alcohol on risk choices (Lane et al., 2004). On the other hand, studies conducted in naturalistic drinking settings find contrasting results whereby risk-taking is negatively associated with blood alcohol concentration (Lyvers et al., 2015; Proestakis et al., 2013). In other words, the more intoxicated people are, the less likely they are to take risks. Such findings point to possible compensatory responding where individuals will attempt to offset anticipated effects of alcohol consumption. To this end, laboratory and field work find opposing effects of alcohol consumption on risky behaviour. These inconsistencies may be a consequence of the environment and contextual difference between these studies, which have previously

been suggested to impact alcohol-related cognitions (Monk & Heim, 2013a, 2013b, 2014b).

Alcohol consumption is largely a social activity (Gordon et al., 2012), and it is therefore likely that social influences in natural drinking settings will play a major role in alcohol-related behaviours. Monk and colleagues have addressed such environmental and contextual (including social context) influences in the field of alcohol-related cognitions using a variety of different tasks and methods (experimental, Monk & Heim, 2013; field, Monk & Heim, 2013b; ecological momentary assessment, Monk & Heim, 2014; Monk, Heim, Qureshi, & Price, 2015). Moreover, social contexts have been found to increase risk-taking, independent of alcohol (Gardner & Steinberg, 2005; E. K. Reynolds et al., 2013). Overall, these findings point to the importance in considering how both social and environmental factors may impact alcohol behaviours in the real world, and more specifically alcohol-induced risk-taking.

Peers and social contexts have further been postulated to influence alcohol-related behaviour via perceived drinking norms (Borsari & Carey, 2001; Halim et al., 2012). Here, it is suggested that individuals tend to overestimate the quantity and frequency of their fellow peers' alcohol consumption (descriptive norms) (Borsari & Carey, 2001; Carcioppolo & Jensen, 2012; Halim et al., 2012), as well as their approval of alcohol consumption and risk drinking practices (injunctive norms) (Iwamoto et al., 2011; Kenney et al., 2013). These normative (mis) perceptions, in turn, have been found to correlate with one's own alcohol use (Borsari & Carey, 2001) and intoxicated behaviours (e.g., drink driving; Kenney et al., 2013), as it is believed that people alter their behaviour to meet the perceived norm. The identification of injunctive norms



relating to alcohol-induced risk may therefore be fruitful in future feedback interventions attempting to correct such misperceptions and subsequently reduce potentially harmful risky behaviours in social drinking settings.

The contribution of social and contextual influences on risk-taking behaviour whilst intoxicated has rarely been examined, with few notable exceptions (Abrams et al., 2006; Hothrow et al., 2014; Sayette, Dimoff, et al., 2012). The diminutive research examining such have largely been tested in laboratory environments, and findings have shown inconsistencies. For example, intoxicated groups increase risk choice (Sayette, Dimoff, et al., 2012), or compensate for alcohol-induced risk-taking (Abrams et al., 2006). Even less research has investigated the combined influences of intoxication and social influences on risk-taking within real, natural contexts (c.f., Hothrow et al., 2014). The adoption of research in this regard, is important to further understand the inconsistencies highlighted between field and experimental work in this area (c.f., Lane, Cherek, Pietras, & Tcheremissine, 2004; Lyvers et al., 2015; Proestakis et al., 2013; Rose, Jones, Clarke, & Christiansen, 2014), in light of social and contextual effects. Moreover, testing such behaviours in natural environments may offer more valid and reliable findings when generalising back to real world behaviour.

The current study aimed to examine risk-taking behaviour (via a lottery task and self-reported alcohol-related risk engagement) in a natural alcohol and non-alcohol-related social environment (a student union bar and communal area), whilst also assessing the association between intoxication, alcohol-related risk injunctive norms and risk-taking. It was hypothesised that risk-taking would increase in the alcohol-related environment, and with increasing group size and perceptions of peer approval

for alcohol-related consequences (alcohol-related risky injunctive norms). It was further expected that higher BrAC to predict elevated risk-taking. Finally, a positive association between perceived peer approval and self-reported experience of alcohol-related risk outcomes was predicted.

## Method

### Design

The study used a between participants design across two natural environments: a student union (SU) bar (alcohol-related) and a university communal hub (non-alcohol-related). Level of intoxication (via mg/l BrAC), alcohol-related risk injunctive norms and experiences (via questionnaire), and risk-taking (via lottery task) were measured in both environments.

### Ethical considerations

In the student union bar, data was collected before 22:00 to reduce the likelihood of highly intoxicated individuals, who may be unable to knowingly consent with understanding of the study aims and instructions (Monk & Heim, 2013b). To further protect against this, an ethically defined upper breath alcohol concentration limit of .79mg/l was used, consistent with previous research (c.f., Lyvers et al., 2011).

### Participants<sup>10</sup>

In total, 138 participants were recruited in groups made up of two to nine members ( $M = 3.97$ ,  $SD = 1.83$ ). Females represented 47% of the sample ( $N = 65$ ), and participants were aged between 18-39 years ( $M = 21.02$ ,  $SD = 4.09$ ). A total of 20 groups ( $N = 71$ ) participated in the communal hub, and 21 ( $N = 67$ ) in the SU bar. The proportion of different group gender composition (all female, all male or mixed sex) differed significantly between contexts,  $\chi^2(2, N = 41) = 6.24$ ,  $p = .04$ ,  $Cramers V = .39$ .

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<sup>10</sup> An a priori power analysis conducted using G\*Power 3.1.9.2 revealed a minimum of 128 participants to achieve a power of .80

Namely, 57% of the groups recruited in the SU bar were all male, compared to 20% in the communal hub. In contrast, a higher proportion of mixed sex groups were tested in the non-alcohol-related environment (45% compared to 19% in alcohol-related environment). The proportion of all female groups however, were similar across both contexts (35% in hub and 24% in SU bar).

## **Materials and measures**

**Alcohol Use Disorder Identification Task (AUDIT;** Saunders, Aasland, Babor, de la Fuente, Grant, 1993). The AUDIT showed high internal consistency in the current sample (Cronbach's  $\alpha = .85$ ).

**RT-18** (de Haan et al., 2011). All items, and those within each subscale, showed high internal consistency (all Cronbach's  $\alpha > .71$ ).

**Subjective Intoxication Scale (SIS).** The scale was found to have high internal consistency in the current sample (all Cronbach's  $\alpha > .77$ ).

**Young Adult Alcohol Consequences Questionnaire (YAACQ;** Read, Kahler, Strong, & Colder, 2006) assess a range of harmful drinking consequences experienced in the last month. Only the 'Risky Behaviour' subscale was used in the current study which included items such as "I have driven a car when I knew I had too much to drink to drive safely". As a measure of perceived injunctive norms, a second part of the questionnaire was included in which participants were asked whether their friends would find each of these behaviours acceptable. The risk-taking subscales showed high

internal consistency, both when assessing participants own behaviour (Cronbach's  $\alpha = .77$ ) and with regards to perceptions of friends' approval of these behaviours (Cronbach's  $\alpha = .80$ ).

**Lotteries.** The lotteries method is adapted from Proestakis et al. (2013).

Participants were asked to choose one of six lotteries, which each had varying potential payoffs ranging from £1-£6. As the potential value of the payoff increases in the lottery, the probability of receiving this payoff decreases. As in Proestakis et al. (2013). the expected value of the payoff was kept constant to avoid this as a possible influence (van der Meer, 1963) (see Table 5.1). Risk-taking behaviour was measured by the lottery choice of the participants. For example, a lottery choice of six (17% chance of winning £6) was the riskiest option, whereas a lottery choice of one (100% chance of winning £1) was the most risk adverse. This risk-taking measure was chosen due to its cognitive simplicity, as individuals have previously experienced difficulty in understanding risk-taking tasks (Dave et al., 2010; Proestakis et al., 2013). Furthermore, the duration of the task (one-two minutes) was suited to the field setting, and was not subject to practice effects.

Table 5.1

*Potential prize, probability of success and expected value for each lottery*

Lottery	1	2	3	4	5	6
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Probability (%)	100	50	33	25	20	17
Prize	1	2	3	4	5	6
Expected Value	1	1	1	1	1	1

## Procedure

The communal hub was visited between 12:00 and 16:00, Monday-Friday to collect data (times in which the communal hub is busiest), and testing in the SU bar occurred between 18:00 and 22:00 on Wednesdays (society social night). This timeframe and day was chosen as venue attendance during these times stayed relatively consistent, and the bar was generally well attended.

Attendees in groups of two or more at the SU bar or university communal hub were approached and verbally informed of the study aims and procedure, and provided with a full information sheet. Those who volunteered to participate were breathalysed and if eligible to continue, provided informed consent. All participants were then given an envelope containing their questionnaires, and a verbal explanation of the lottery task, including an overview of the potential payoff and success probabilities. Following this, participants were requested to personally choose and write down their lottery choice on the inside of their envelope, without conferring with other group members. Those who had consumed alcohol were then informed of the drink-driving breath alcohol limit (.35mg/l), and subsequently requested to estimate their breath alcohol concentration. Participants then completed the AUDIT, RT-18 and both versions of the YAACQ. Those tested in the SU bar were also asked to complete a subjective intoxication scale.

After completing the questionnaire, all participants played their chosen lottery in the presence of their social group and were reimbursed for their time (£3) plus any successful lottery wins (£1-6). Finally, participants were fully debriefed and provided with researcher contact details in the case of further information or withdrawal requests.

## Results

### Preliminary analysis

**Participant Characteristics:** Group size ranged from two to nine members ( $M = 3.34$ ,  $SD = 1.43$ ). For those tested in the SU bar, 13 had not consumed alcohol. There was a significant difference of age, AUDIT and RT18 between context conditions (for full descriptive statistics see Table 5.2).

**Group Composition:** A 3 (Gender Composition: Male, Female, and Mixed Sex) X 2 (Context: Alcohol or Non-Alcohol-Related) ANOVA was conducted to ascertain any effect of group composition on risk-taking (via lottery choice), due to group level differences. No significant main effect of gender composition or interaction with context was revealed ( $ps > .32$ ).

**BrAC and Estimated BrAC:** All participants who were tested in the communal hub, and 13 in the SU bar had not consumed alcohol. The remaining 54 participants scored a mean BrAC of .21mg/l ( $SD = .20$ ), similar to previous research of this kind (Hopthrow et al., 2014), three of whom scored .00mg/l and estimated a BrAC of .01mg/l after consuming ‘a sip’ of alcohol. BrAC was positively correlated with estimated BrAC  $r = .69$ ,  $p < .001$ . Participants estimated BrAC ( $M = .27$ ,  $SD = .23$ ) did not differ from their actual BrAC,  $t(53) = 1.86$ ,  $p = .07$ .



Table 5.2

*Descriptive and inferential statistics for age, AUDIT and RT-18*

	Communal Hub N = 71		SU Bar N = 67		<i>P</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Age	22.20	5.13	19.78	1.95	< .001*
AUDIT	11.54	7.44	15.05	6.91	.005*
RT-18	8.52	4.22	10.26	4.19	.02*
YAACQ	8.69	1.83	9.31	1.99	.06
Friends YAACQ	8.36	1.71	9.32	2.10	.004*
Lottery Choice	4.00	1.18	3.81	1.31	.36
BrAC mg/l	---	---	0.21	0.20	---
Estimated BrAC	---	---	0.27	0.23	---

Note: BrAC and estimated BrAC values are based only on participants who had consumed alcohol. \*significant at  $p < .05$ .

### **Risk-taking and context<sup>11</sup>**

A one-way ANCOVA was conducted to examine the difference in risk-taking via lottery choice, between participants tested in the communal hub or SU bar, while controlling for intoxication levels (via inclusion of BrAC as a co-variate). No differences in lottery choice were found between the two context conditions,  $F(2, 135)$

<sup>11</sup> Further statistical analyses were conducted based on three context conditions: (i) communal hub (ii) SU bar – alcohol consumed (iii) SU bar – no alcohol consumed (or BrAC of 0.00mg/l). No effect of context was found on risk-taking behaviour. Results of this analysis can be found in Appendix H.

= .40,  $p = .36$ , indicating that risk-taking was not affected by alcohol-related, compared to non-alcohol-related environments.

A hierarchical regression analysis was then performed overall, and split by context to examine whether group size predicts risk-taking via lottery choice, and whether this differs between environment. Overall, group size was not found to predict lottery choice,  $F(1,135) = .30, p = .74, R^2 = .004, \Delta R^2 = .001, \beta = .03$ . However, when separated by context, group size significantly predicted lottery choice when tested in the communal hub,  $F(1,69) = 4.36, p = .04, R^2 = .06, \beta = .24$ , as larger group sizes in the communal hub predicted higher risk-taking choices on the lottery task. When tested in the SU bar (controlling for BrAC), group size did not predict lottery choice,  $F(1,64) = .50, p = .61, R^2 = .02, \Delta R^2 = .01, \beta = -.12$ , suggesting that the number of group members present is only associated with risky behaviour in contexts which are not alcohol-related.

### **Risk-taking and BrAC: actual and estimated**

Two separate linear regressions were conducted to investigate whether BrAC and estimated BrAC predicted risk-taking behaviour on lottery choice. Lottery choice was not predicted by either BrAC,  $F(1,136) = .52, p = .47, R^2 = .004, \beta = -.06$  or estimated BrAC,  $F(1,136) = .70, p = .40, R^2 = .005, \beta = -.07$ , suggesting that intoxication level was not associated with risk-taking on the lottery task.

### **Risk-taking and injunctive norms**

A hierarchical regression analysis was carried out to examine the predictive utility of perceived peer acceptability of alcohol-risk consequences (via the modified version of the YAACQ) on lottery choice, while controlling for BrAC. Analysis was conducted overall and separated by context. Perceived peer acceptability of alcohol consequences did not predict risk-taking behaviour overall,  $F(1,136) = .74, p = .39, R^2 = .005, \beta = .07$ . Neither was this found when separated by context: communal hub,  $F(1,69) = .04, p = .85, R^2 = .001, \beta = -.02$  or SU bar (controlling for BrAC),  $F(1,64) = 1.25, p = .29, R^2 = .04, \Delta R^2 = .008, \beta = .19$ . This suggests that overall, self-reported perceived injunctive norms regarding alcohol-related risk, are not associated with risky choices on lottery tasks.

### **Context, BrAC and injunctive norms**

An ANCOVA and linear regression were conducted to examine the impact of context while controlling for intoxication levels, and BrAC independently on perceived peer acceptability of alcohol consequences. Findings indicate that participants tested in the SU bar perceived peers to be more acceptable of alcohol consequences, than those tested in the communal hub,  $F(1,135) = 5.33, p = .02, \eta_p^2 = .04$ . However, BrAC was not found to significantly predict perceived peer acceptability of alcohol consequences,  $F(1,52) = .05, p = .83, R^2 = -.02, \beta = .03$ , indicating that perceived alcohol-related risky injunctive norms are context dependent. Here, injunctive norms are perceived as more approving of alcohol-related risky behaviour when the environment is alcohol-related.

Finally, a Pearson's correlations found YAACQ was positively correlated with perceived acceptability of alcohol consequences (via the modified version of the

YAACQ),  $R = .46$ ,  $p < .001$ , indicating an association between perceived alcohol-related risk injunctive norms and engagement in alcohol-related risky behaviours.

## Discussion

The current study aimed to investigate the influence of social environment (alcohol-related versus non-alcohol-related), group size, intoxication levels (both actual and estimated), and perceived injunctive norms on risk-taking behaviour. Findings indicate that risk-taking behaviour was not affected by the testing environment, intoxication or perceived injunctive norms. However, larger group size predicted enhanced risk-taking behaviour in the non-alcohol-related environment. The study further expected alcohol-related environments to increase (and intoxication to be associated with) alcohol-related risk injunctive norms, which would subsequently be associated with self-reported alcohol-related risk engagement. To this end, although BrAC did not predict perceived injunctive norms, those in the alcohol-related environment believed peers would approve of more risky alcohol consequences. Finally, higher perceived peer approval of alcohol-related risk outcomes significantly predicted experiences of these consequences.

Against predictions, BrAC (actual or estimated) was not associated with risk behaviour, either positively or negatively. Such a finding is in apparent contrast with previous research suggesting a negative association between BrAC and risk-taking utilising the same lottery task (Proestakis et al., 2013). However, methodological variations may offer some insights into such apparent differences. For example, the mean BrAC of participants in Proestakis et al. (2013) was more than double that of the current sample (.21) and therefore participants may not have reached levels of intoxication which would impact risky behaviour to a comparable degree. The difference in observed BrAC between the two studies may also be a result of the varying contexts; where alcohol consumption appears more excessive at large events

(e.g., festival; Proestakis et al., 2013), than more typical drinking occasions (as in the current study).

To investigate whether the null findings was a consequence of inadequate sample size, a post-hoc power analysis using G\*Power 3.1.9.2, with the sample size of 138 and a one predictor variable (BrAC) equation was used as a baseline. The effect sizes used for this assessment were as recommended by Cohen (1977):  $f^2 = 0.02$  (small),  $f^2 = 0.15$  (medium) and  $f^2 = 0.35$  (large). The alpha level was set at  $p < .05$ . The analyses showed that the statistical power was 0.38 for detection of a small effect, 0.99 for detection of a medium effect and 1.00 for a large effect size. Therefore, there was sufficient power (above 0.8) for the medium to large effect size level, but less than sufficient power at the small effect size level. Due to the small effect found between BrAC and risk-taking ( $R^2 = .004$ ), it is possible that a larger sample size was required find a stronger level of significance. However, it is unlikely that increased participant numbers would enable this association to reach significance.

The current findings may further be understood through the absence of a context effect on risk-taking. Although research suggests that individuals will be more disinhibited when exposed to alcohol-related cues (Jones & Field, 2015; Weafer & Fillmore, 2015), the current study's failure to find an influence of drinking context on risk-taking, may demonstrate the significance of the social group itself. In other words, in non-alcohol-related environments, the presence of others may still heighten risk-taking behaviour (c.f., Erskine-Shaw et al., 2017; E. K. Reynolds et al., 2013) to a level comparable to the effects of alcohol-related cues in drinking environments. Indeed, the superseding influence of social contexts has previously been found to dampen

associations of personality traits and alcohol consumption behaviour (Kuendig & Kuntsche, 2013). In conjunction with previous research indicating the independent influences of social groups (regardless of context) (Erskine-Shaw et al., 2017) findings of the current study may point towards a dominant effect of groups, which may ameliorate the traditionally observed effect of alcohol on risk taking.

Interestingly, the current study did reveal an effect of environment on lottery risk-taking in that larger social groups predicted increased individual risk-taking behaviour in the non-drinking environment only. There has been little previous research in this area and, as such, not much is known about the effects of groups size and alcohol-related risk-taking in different environments. However, research in support of the '*risky shift*', where groups appear to engage in riskier choices than individuals (Isenberg, 1986; Moscovici & Zavalloni, 1969), does suggest that such effects are pronounced as group size increases (Teger & Pruitt, 1967), supporting the current findings in the non-alcohol-related environments. The absence of group size influences in the SU bar environment, may therefore in part be understood through alcohol myopia explanations, whereby intoxication causes focal narrowing (Steele & Josephs, 1988; Steele & Josephs, 1990), resulting in reduced attention towards group size. In other words, results of the current study may suggest that reduced attention to some group characteristics in bar contexts may constrain the impact of group size on risky-behaviour, while this is not the case in a neutral environment where alcohol has not been consumed.

Although lottery risk-taking was not found to be influenced directly by context, in line with predictions, perceptions of other's opinions surrounding risk-taking

(injunctive norms) were influenced by alcohol-related environments. Here, those in the SU bar believed peers to approve of more risky alcohol consequences, compared to those tested in the communal hub. Furthermore, these perceived injunctive norms were positively associated with experienced alcohol consequences, supporting similar research finding alcohol-related perceived injunctive or descriptive norms to correlate with one's own alcohol use behaviour (Goode et al., 2014; Halim et al., 2012; LaBrie, Hummer, Huchting, & Neighbors, 2009). The current findings therefore offer two potentially important insights for interventions in this area. First, injunctive norms surrounding alcohol-related risky behaviour are not static and should thus be assessed in a variety of different contexts, including real-life drinking environments (c.f., Monk & Heim, 2014). Second, interventions using injunctive norm feedback may be a beneficial way of identifying and targeting misperceptions which may lead to harmful drinking practices.

Finally, group level differences were identified as participants tested in the drinking environment reported higher trait risk-taking (RT-18) and typical alcohol consumption behaviour (AUDIT). It is likely that the differences observed are due to the environment and are representative of these two contexts. For example, Monk and Heim (2013) found participants to self-report higher levels of typical alcohol consumption when tested in a bar, opposed to lecture context. Furthermore, perceived norms are suggested to be context dependent, whereby alcohol-related environments will trigger normative beliefs associated with alcohol (Lo Monaco et al., 2011; Monk & Heim, 2014b). Along this line of thought, current findings suggest that injunctive norms regarding alcohol and engagement in risky behaviour may be more dominant in the alcohol-related environment, which may influence response of risk-taking questions on the RT-18.



A number of limitations need to be considered when interpreting the current findings. Recruitment times for the drinking environment were relatively early to capture intoxicated individuals, and many participants had only recently commenced drinking. For this reason, mean BrAC was relatively low (.22mg/l). Although these levels are consistent with other field research in this area (see Hothrow et al., 2014), testing at later times in the evening may provide a more varied sample of intoxicated participants. Further, participants may be more likely to be on the descending limb of the blood alcohol curve during later times, which is when risk-taking has been suggested to be at its highest (Bidwell et al., 2013). Expanding testing times in the future may thus further illuminate research in this area. Also, the attractiveness of outcomes in the lottery task may warrant consideration, in light of previous studies using larger rewards of between €10 - €60 (Proestakis et al., 2013). A further consideration of testing times is warranted regarding the influence of circadian rhythms (Roehrs, Zwyghuizen-Doorenbos, Knox, Moskowitz, & Roth, 1992). Due to the varied testing times between contexts (afternoon versus evening), participants may be subject to effects of alertness and sleepiness, which has previously been found to influence risk-taking behaviour following alcohol consumption (Roehrs, Greenwald, & Roth, 2004). To this end, it would be beneficial for future research to attempt to match testing time, or adopt additional measures to control for such effects. Finally, in addition to addressing such methodological limitations surrounding BrAC level and prize appeal, the utilised risk-taking task may also be influenced by people's experience and beliefs of gambling (Ellery & Stewart, 2014), and future research may benefit from investigating various risk domains, other than gambling.

Overall, the current study examined the influence of natural alcohol-related environments, intoxication, group size, and injunctive norms on risk-taking behaviour.

Findings did not support an effect of alcohol-related environments on lottery risk-taking but did imply that larger groups in non-alcohol-related environments may be more prone to engaging riskier behaviour. As such, results may suggest that social influences on risky behaviour are less pronounced in alcohol-related environments due to reduced attention to group characteristics. Finally, participants perceived their peers to approve of more risky drinking consequences when tested in alcohol-related environments, suggesting injunctive norms to be context-dependent. As findings imply perceived injunctive norms to predict one's own behaviour, the identification of these beliefs is important to aid feedback interventions to reduce misperceptions, and consequently risky drinking behaviour.

### **Chapter Conclusions**

Chapter 5 detailed the final empirical study of the thesis, which investigated the association between intoxication and risk-taking across different natural social contexts (alcohol and non-alcohol-related). Further, building on potential group norm influences addressed in the discussion of former chapters (Chapter 3 and 4), the current study explored the role of alcohol-related risk injunctive norms on risky behaviour (*in situ* and in the previous month). Differing from lab-based studies (particularly Study 3 of the thesis) alcohol was not found to be associated with risk-taking in natural settings. However, the alcohol-related context resulted in riskier injunctive norms, which further were associated with increased alcohol-related risk-taking behaviour in the previous month. The chapter therefore concludes that the influence of alcohol and context on risk-taking engagement may in part be due to the activation of context-specific injunctive norms. The chapter further points to the importance of investigating lab-based findings in more natural settings to allow for more confident generalisation to real world behaviours.

## Chapter 6 A meta-analysis of experimental alcohol administration research

### Abstract

**Background:** Research frequently identifies alcohol consumption as an influence on risk-taking. However, to date, the effect of alcohol across risk domains other than sexual risk, has not yet been assessed by meta-analyses of alcohol administration studies.

**Method:** A systematic review and meta-analysis was conducted on alcohol administration studies assessing alcohol versus placebo on risk-taking behaviour generally, and across specific domains. A second phase was also conducted for studies which included a comparison between group versus isolated contexts. Systematic literature searches across three databases (Web of Science, PsycINFO and PsycARTICLES) revealed 22 eligible studies ( $k = 35$ ) for meta-analysis. Only 3 studies ( $k = 4$ ) were eligible in phase two and were therefore not quantitatively synthesised.

**Results:** Alcohol was found to have a small but significant effect of risk-taking behaviour overall, and on domain-specific risks: driving and gambling. However, no effect of alcohol was revealed on non-specific measures of risk-taking. **Conclusion:** Alcohol consumption increases risk-taking behaviour, although findings outline the importance of attending to domain-specific measures (as opposed to general measures) to enable generalisation back to behaviours associated with alcohol consumption. Moreover, the diminutive research addressing both social and alcohol influences on risk-taking highlights the need for future research to consider possible effects of social contexts associated with drinking.

## Introduction

The relationship between alcohol use and risk-taking behaviour is complex, as although much research supports the association between the two (Courtney et al., 2012; Lane et al., 2004; Proestakis et al., 2013), the direction of causality is unclear (de Wit, 2008). To ascertain causal direction, controlled experimental studies have historically administered alcohol to establish how intoxication (compared to sobriety) affects subsequent performance on various risk-taking tasks. To date, meta-analyses examining the effect of alcohol on risky behaviour in such studies have looked mostly at sexual-related risk-taking (c.f., Rehm et al., 2012; Scott-Sheldon et al., 2016), despite alcohol being implicated in other risk domains such as drink driving (Berthelon & Gineyt, 2014; Burian et al., 2002) and gambling (Ellery & Stewart, 2014; George et al., 2005). Through examining the influence of alcohol on a variety of risk domains, a clearer picture may be established of the extent to which alcohol affects risky behaviour, and how that effect may vary depending on the risk-taking type.

The effects of alcohol on risky behaviour are argued to be a consequence of pharmacologically-induced cognitive deficits in two domains relating to decision making: inhibition and attention (Dry et al., 2012; Steele & Josephs, 1988). Research suggests that deficits in these areas are associated with diminished cognitive and behavioural constraint, and a narrowing of attention, both of which impede full systematic evaluation of a given situation (Giancola et al., 2010). However, research findings in this area are mixed. On the one hand, a wealth of research finds heightened risk-taking following alcohol consumption (Bidwell et al., 2013; Gilman et al., 2012; Rose et al., 2014), which is further suggested to be linear; risk-taking increases in line with rising alcohol dose (Lane et al., 2004). On the other hand, other studies have found no

effect of alcohol on risk-taking behaviours (Farquhar, Lambert, Drummond, Tiplady, & Wright, 2002; Peacock et al., 2013; S. C. Reed et al., 2012). Moreover, field studies examining blood alcohol concentration (BAC) in natural drinking environments suggest that risk-taking may reduce with increasing intoxication (both actual and perceived) (Lyvers et al., 2015; Proestakis et al., 2013) as people may attempt to compensate for perceived alcohol-induced increases in risky behaviour. The relationship between alcohol and risk appears complex and therefore, there is a need to quantitatively synthesise such previous work to assess the magnitude of alcohol's effect on risk-taking.

The varying definitions and domains of risk-taking behaviour may contribute to the inconsistent findings in this field, as risk is portrayed and assessed differently across studies. In this regard, risk-taking can be construed as heroic or harmful (Leigh, 1999) as not all risky behaviours are perceived as negative (Courtney et al., 2010). Furthermore, risk can be seen to be either uni or multi-dimensional in nature. In other words, risk-taking may be characterised more generally or in relation to a specific risk domain (financial, physical, social, and ethical; Jackson, Hourany, & Widmar, 1972). Indeed, studies investigating alcohol-induced risk-taking utilise a multitude of risk-taking measures across varying domains. For example, alcohol has been found to increase risk-taking in driving simulators (Laude & Fillmore, 2016) and risky gambles (Gilman et al., 2012). However, studies of alcohol-related risk using less specific measures of risky behaviour (e.g., blowing up a balloon to gain hypothetical monetary reward or points; Lejuez et al., 2002) appear to produce less consistent results (c.f. Euser et al., 2011; Rose et al., 2014). To this end, inconsistencies across studies may instead be the result of variations in alcohol effects across different risk domains.

Therefore, it would be appropriate to examine the effects of alcohol both overall, and across the difference risk-taking domains.

A further consideration for research investigating alcohol-induced risk-taking concerns the social nature of alcohol consumption. Alcoholic drinking is frequently a social activity and alcohol often serves as a social lubricant (Gordon et al., 2012; Heath, 2000). However, much of the experimental investigations in this area are conducted in isolated contexts which may bear little resemblance to the contexts in which people frequently consume alcohol. As such, they may not capture the social influences which may be present in real drinking settings (Fairbairn & Sayette, 2014; Hothrow et al., 2014). To address this limitation, researchers have begun to address how such social influences and intoxication interact to shape risky behaviour. For example, following administration of alcohol or placebo, participants are required to complete a risk-taking assessment either in isolation, or with others in a group context (c.f., Abrams et al., 2006; Sayette, Dimoff, et al., 2012), enabling comparison of how social context (isolation versus group) and beverage (alcohol versus placebo) impact risk-taking independently and combined. To date relatively few studies have yielded inconsistent findings by suggesting that groups either heighten (Sayette, Dimoff, et al., 2012) or protect against (Abrams et al., 2006) alcohol-induced risk-taking.

Such discrepant findings may be a result of methodological variations such that researchers may in fact be assessing different processes. For example, in Sayette, Dimoff, et al. (2012), alcohol consumption in groups is followed either by a group risk decision, or extrication of group members for individual risk-choice, while in Abrams et al. (2006), individual and group contexts are kept consistent throughout consumption

and risk-taking assessment. Therefore, findings from Sayette, Dimoff, et al., (2012) may be influenced by the social contexts in which alcohol was consumed, even when decisions were made in isolation afterwards. In support of the notion that the contexts in which drinking occurs may influence subsequent behaviour, the alcohol myopia model (AMM; (Steele & Josephs, 1990) suggests that when intoxicated, attention is narrowed. As such, focus may be directed towards peers, which in turn influences behaviour in line with perceived norms of their social group (Borsari & Carey, 2001). Consideration of such social influences when examining behaviours in settings more akin to naturalistic drinking contexts is therefore necessary to fully understand the effects of social drinking on risky behaviour. Accordingly, there is a need to fully consider the role of social contexts/influences both independently and in combination with alcohol consumption on risk-taking behaviour, to enable generalisation of findings back to real world social drinking settings.

Overall, this meta-analysis aims to synthesise existing data investigating the effect of an alcohol (compared to a control) on risk-taking (phase one), and the combined influence of intoxication and social context (group versus isolated testing conditions) (phase two). Alcohol administration studies which included an outcome measure of risk-taking (behaviour or self-assessment) were reviewed. Following this, a series of meta-analyses were carried out to examine the effect of alcohol consumption on subsequent risk-taking behaviour (1) overall and (2) separated by risk-taking behaviour measured (e.g., driving, gambling or non-specific).

## Method

The meta-analysis was conducted in line with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses; Moher et al., 2009) guidelines, and consists of multiple stages: search strategy via title and abstract, assessment of inclusion/exclusion criteria of full text and quality assessment. Data extraction and synthesis via meta-analyses were then carried out on the selected studies.

### Search strategy

Systematic literature searches were conducted across three electronic databases: Web of Science, PsycINFO and PsycARTICLES, using a Boolean search strategy (PsycINFO and PsycARTICLES were searched simultaneously through EBSCO host). Searches included a combination of alcohol, risk-taking and administration keywords. Search terms used for alcohol were 'alcohol' OR 'alcohol\* adj drink\*'. Risk-taking behaviour terms consisted of 'risk-taking' OR 'risk\* adj behav\*' OR 'risk\* adj assess\*' OR 'decision making'. Administration keywords searched were 'preload' OR 'administration' OR 'dose' OR 'acute'. A second phase of literature searches was conducted to locate studies which included consideration of social contexts. For this the terms 'social' OR 'group\*' OR 'peer\*' were combined with the previous search terms. Additional filters were applied to only include articles available in English. Initial searches were conducted in August 2016, with subsequent weekly email alerts. A final search to identify any remaining literature not captured in the email alerts, was conducted on 24/07/2017. A search for grey literature was carried out by requesting any known relevant unpublished data from correspondents listed on included studies (for those who could be reached via their provided contact details), and research groups who were known to the authors to specialise in alcohol administration research ( $N = 4$ ).



Finally, an examination of the reference lists for the selected manuscripts was carried out to identify any further potentially applicable articles.

### **Inclusion/exclusion criteria**

Articles were included in the meta-analysis if they met the following inclusion criteria:

1. Design: experimental alcohol administration study.
2. Population: Human studies and adult sample only.
3. Comparators: a control or placebo administration condition in addition to an alcohol administration condition. For studies including social context, comparators to include a social (tested in groups) and isolated context.
4. Comparators: a specified dose of alcohol and duration of consumption,
5. Outcomes: A measure of risk-taking following beverage administration.

However, articles were excluded if they included any of the following:

1. Design: an intervention study
2. Population: clinical populations (e.g., participants with alcohol disorders)
3. Outcomes: As impulsivity and risk-taking are not seen as synonymous constructs, risk-taking measures which examined only impulsivity (for example delay discounting) were excluded. Sexual risk-taking was also excluded.

### **Quality assessment**

To ensure synthesis of high quality papers, studies were only selected if: (1) the allocation of beverage was randomised and (2) participants fasted from food and alcohol prior to participation for a specified duration

## Data extraction

To calculate effect size, the mean and standard deviation (SD) of risk-taking for each comparator (alcohol, placebo and/or control) was extracted from the articles. Effect sizes were computed for each sub-group in studies which examined multiple alcohol dosages. Further, for studies which included additional sub-groups not of interest for current meta-analysis (e.g., pathological versus non-pathological (control) gamblers; Ellery & Stewart, 2014), only the effect size from the control sub group was reported. However, when sub groups did not include a pure control, an overall mean and SD was averaged from the groups (e.g., groups comprising alert and sleepy; Roehrs et al., 2004). In cases where standard error was reported, this was converted into SD ( $k = 3$ ). In the absence of means and SD's, the effect size reported in the paper was extracted or  $F$  values were used to calculate effect size ( $k = 5$ ). For those which did not report either, authors were contacted to request information (of the 13 authors contacted, six provided requested data, three did not have access to the data, and the remaining four did not respond). Effect sizes were coded to ensure that positive effect sizes indicated an increase in risk-taking following alcohol consumption.

Additional data collected from the article for moderator analysis were age, gender composition, study design, and risk-taking measure. Risk-taking measure was categorised into: gambling, risky driving and non-specific risk-taking (e.g., BART). Average blood alcohol concentration (BAC) measured prior to the risk-taking task was also recorded for moderator analysis. Studies reporting breath alcohol concentration (BrAC) were converted to BAC via the Lion Units Converter (<http://www.lionlaboratories.com/testing-for-alcohol/the-lion-units-converter/>). Where this information was not reported, target BAC was used ( $k = 5$ ).

## **Statistical analysis**

All analyses were performed in R, using the metaphor package (Viechtbauer, 2009). Firstly, a meta-regression (moderation analysis) was conducted to determine any potential moderators from sample characteristics: age, and gender composition, and methodological differences: BAC (average or targeted), design, and risk-taking task. Meta-analyses via a random effects model were then performed to examine the effect of alcohol on risk-taking behaviour. These were conducted overall and separated by risk-taking type to identify the strength of alcohol effects of various types of risky behaviour. Finally, to assess publication bias, a funnel plot and asymmetry was examined using Eggers weighted regression test.

## Results

### Study and sample characteristics

**Alcohol and risk-taking.** Initial database searches yielded 571 articles from PsycINFO and PsycARTICLES (EBSCO host automatically excluded 27 exact duplicates), and 3424 from Web of Science. Following screening of titles and abstracts, 79 articles were retained for full paper reviews. Subsequently, 22 articles, containing 35 comparisons ( $n = 778$ ) were selected for analysis (see Figure 6.1 for exclusion details after full paper reviews).

Overall, average age ranged from 19.50 to 38.80 years ( $M = 25.52$ ,  $SD = 4.21$ ) (for studies reporting only range, a median between the lower and upper range was extracted). Females made up 49% of the total participants. The majority of studies were within participant designs (68%) and all studies compared alcohol versus placebo. Further, fasting prior to participation and abstinence from alcohol consumption, ranged from 12 hours to three days before testing. See Table 6.1 for characteristics of each of the selected studies.

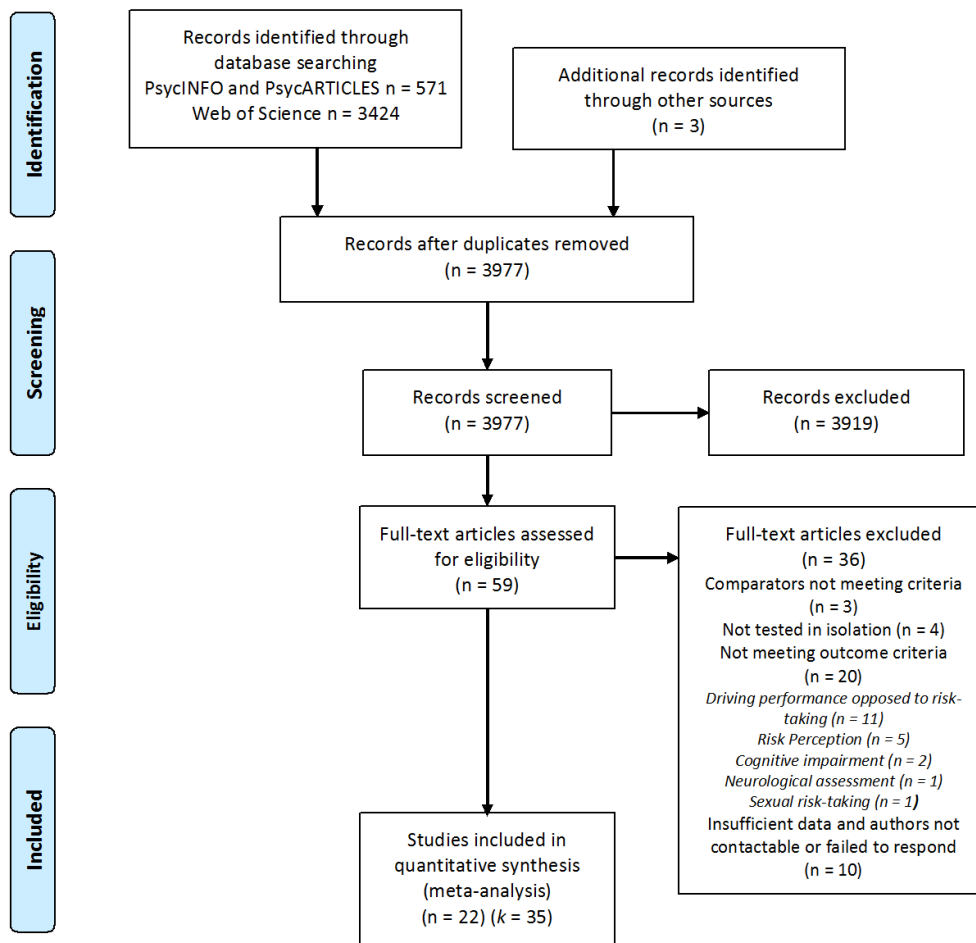


Figure 6.1 Flow diagram depicting the search strategy for quantitative synthesis of experimental alcohol and risk-taking studies.

**Social context, alcohol and risk-taking.** Search results of databases yielded 316 hits from PsycINFO and PsycARTICLES, and 1198 from Web of Science (excluding duplicates), which resulted in only one eligible article (Abrams et al., 2006) and a further two under review were selected, (Erskine-Shaw et al, 2017a; 2017b) ( $k = 4$ ). Due to the limited amount of data, a meta-analysis was not conducted on social context, alcohol and risk-taking. However, the isolation condition was used from these studies in the alcohol and risk-taking meta-analysis.

Table 6.1

*Characteristics of selected studies for quantitative synthesis*

<b>Study</b>	<b>K</b>	<b>Design</b>	<b>Sample</b>	<b>Alcohol Administration</b>	<b>Risk-Taking Measure</b>	<b>M %BAC</b>
Abrams et al. 2006	1	Between	Participants were tested in groups or in isolation. Only those tested in isolation were included. $N = 24$ aged between 18 – 28 years	Drink: 1.13 g/kg	<i>Gambling</i> : Self-reported level of commitment to 16 duplex bets (Slovic & Lichtenstein, 1968)	0.07
Berthelon & Gineyt 2014	3	Within	$N = 16$ (50% female). $M$ age = 25.31 years, $SD = 2.87$	Drink: 0.3/0.5/0.8 g/l	<i>Driving</i> : Intervehicle time on a simulated driving task	(1)0.03 (2)0.06 (3)0.08
Bidwell et al. 2013	2	Within	$N = 40$ (50% female).  40 mg/dl dose: $M$ age = 29.00 years, $SD = 11.4$ . 80 mg/dl: $M$ age = 30.0, $SD = 8.3$	Drink: 40/80 mg/dl	<i>Gambling</i> : Probability discounting	(1)0.04 (2)0.08

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Ellery & Stewart 2014	1	Between	Participants included pathological and nonpathological gamblers. Only nonpathological were included. $N = 30$ (33% female). $M$ age = 34.57 years, $SD = (13.54)^*$	Drink: target 0.06g% BAC	<i>Gambling</i> : Double up bets on a video lottery terminal (poker).	0.06
Erskine-Shaw et al. 2017a	2	Between	Participants were tested in groups or in isolation. Only those tested in isolation were included. $N = 48$ social drinkers (69%). $M$ age = 20.63 years, $SD = 4.30$	Drink: 0.5 g/kg for females and 0.6 g/kg for males	(1) <i>Other</i> : Mean adjusted average pumps on the Balloon Analogue Risk Task (BART) (Lejuez et al., 2002). (2) <i>Driving</i> : Percentage of risk-taking decisions at intersections on the Stoplight Task (Chein et al., 2011)	0.07
Erskine-Shaw et al. 2017b	1	Between	Participants were tested in groups or in isolation. Only those tested in isolation were included. $N = 48$ social drinkers. $N = 20.50$ , $SD = 2.99$ . $M$ age = 20, $SD = 2.34$	Drink: 0.8 g/kg	<i>Other</i> : Average distance of bottle slide on the Shuffleboard Game	0.09

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Euser et al. 2011	1	Between	$N = 64$ males. $M$ age = 20.51 years, $SD = 1.99$	Drink: 0.65 g/kg	<i>Other</i> : Mean number of points of the automatic version of the BART (Pleskac et al., 2008)	0.08
Farquhar et al. 2002	2	Within	$N = 20$ female light to moderate social drinkers, aged 19–20 years	Drink: 0.7 g/kg	(1) <i>Other</i> : Gap and selected line difference (penalised for over-estimating, but not under-estimating) on a size estimation task. (2) <i>Other</i> : Response to correct value ratio (penalised for incorrect responses higher, but not lower than the correct answer) on a general knowledge task	0.08
Fillmore et al. 2008	1	Within	$N = 14$ (50% female). $M$ age = 23.5 years, $SD = 3.2$	Drink: 0.6 g/kg	<i>Driving</i> : Failure to stop at red lights on a driving simulator task	0.07
Gilman et al. 2012	1	Within	$N = 20$ social drinkers (60% female). $M$ age = 26.1 years, $SD = 2.8$	Intravenous: target 0.8g% BAC	<i>Gambling</i> : Percentage of risky choices over safe choices with guaranteed wins, on the Lane	0.07

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					Risk-Taking Task (Lane & Cherek, 2000)	
Harrison & Fillmore 2011	1	Between	Only groups measuring risk-taking without distraction were included. $N = 20$ (50% female). $M$ age = 24.0 years, $SD = 3.8$	Drink: 0.65 g/kg	<i>Driving</i> : Failure to stop at red lights on a driving simulator task	0.08
Lane et al. 2004	3	Within	$N = 16$ social drinkers (50% female). $M$ age = 32.13 years, $SD = 1.30$	Drink: 0.2/0.4/0.8 g/kg	<i>Gambling</i> : Mean number of risky responses on the Lane Risk-Taking Task	(1)0.02 (2)0.04 (3)0.08
Laude & Fillmore 2016	1	Within	$N = 40$ (53% female). $M$ age = 24.08 years, $SD = 4.03$	Drink: 0.56 g/kg for females and 0.65 g/kg for males	<i>Driving</i> : Time to collision on a simulated driving task	0.07
Peacock et al. 2013	1	Within	$N = 28$ (50% female). $M$ age = 19.5 years, $SD = 1.8$	Drink: 0.5 g/kg	<i>Other</i> : Mean adjusted average pumps on the BART	0.06
Reed et al. 2012	2	Within	$N = 47$ female heavy and light drinkers (scores of both groups)	Drink: 0.5/0.75 g/kg	<i>Other</i> : Mean adjusted average pumps on the BART	(1)0.06 (2)0.09

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			were averaged for analysis). <i>M</i> age = 28.1 years, <i>SD</i> = 4.55			
Richards et al. 1999	2 Within	<i>N</i> = 24 (33% female) aged between 21 – 35 years	Drink: 0.5/0.8 g/kg	<i>Gambling</i> : Probability discounting	(1)0.05 (2)0.07	
Roberts 2006	2 Within	Participants included driving under the influence offenders and a control group. Only the control group was included. <i>N</i> = 20 (35% female). <i>M</i> age = 24.9 years, <i>SD</i> = 3.7	Drink: 0.65 g/kg	<i>Driving</i> : Risk slope on risk versus reward driver decision task for (1) BAC, and (2) time since last drink	0.06	
Roehrs et al. 2004	1 Within	Participants were divided into conditions ‘sleepy’ or ‘alert’ following testing. Scores of these conditions were averaged for the current meta-analysis  <i>N</i> = 13 (54% female) aged between 21 – 35 years	Drink: 0.5 g/kg	<i>Other</i> : Percentage of attempt to complete 100 x-y key combinations on the Stop Light Task	0.04	

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Rose et al. 2014	1	Between	$N = 142$ (53% female). $M$ age = 20.33 years, $SD = 3.74$	Drink: 0.6 g/kg	<i>Other</i> : Mean adjusted average pumps on the BART	0.08
Van Dyke & Fillmore 2015	1	Within	$N = 50$ (28% female) between 21 – 34 years	Drink: 0.65 g/kg	<i>Driving</i> : Failure to stop at red lights on a driving simulator task	0.05
Van Dyke & Fillmore 2017	2	Within	$N = 20$ (50% female). $M$ age = 24.0 years, $SD = 3.0$	Drink: 0.5/0.7 g/kg	<i>Driving</i> : Time to collision on a driving simulator task	(1)0.05 (2)0.08
Veldstra et al. 2012	3	Within	$N = 17$ (47% female). $M$ age = 23.6 years, $SD = 3.8$	Drink: target 0.30/0.50/0.80% BAC	<i>Driving</i> : Size of gap (in seconds) between own and leading car on a driving similar task	(1)0.03 (2)0.05 (3)0.08

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## **Moderation analysis**

**Sample characteristics.** Meta-regression revealed no potential moderation of either age or gender composition on alcohol-induced risk-taking ( $p > 0.12$ ).

**Study characteristics.** Neither BAC, design (within versus between participants), or risk-taking measure were found to moderate the effects of alcohol on risky behaviour ( $p > 0.10$ ).

## **Meta-analysis: alcohol and risk-taking behaviour**

A random effects model using restricted maximum likelihood revealed an overall increase in risk-taking behaviour following alcohol consumption (compared to placebo)  $g = 0.23$ , 95% CI = 0.14, 0.33,  $p < 0.001$ , demonstrating a small effect of alcohol on subsequent risky behaviour. As illustrated in the corresponding forest plot (see Figure 6.2), out of 35 interactions included in the meta-analysis, nine showed a small effect of alcohol on risk-taking behaviour in the hypothesised direction (increased risk-taking). An additional five interactions revealed a moderate effect and one displayed a large effect of alcohol consumption on risky behaviour (Abrams et al., 2006). The remaining studies did not display an effect of alcohol on risk-taking behaviour ( $g < .20$ )<sup>12</sup>.

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<sup>12</sup> Those presenting a decreased trend in risk-taking following alcohol, did not reach a notable effect size ( $g = -0.01$  to  $-0.14$ ) ( $k = 6$ ). Additionally, 13 interactions trending in the hypothesised direction displayed below the standard small effect size,  $g > 0.20$ . A further one interaction revealed no effect ( $g = 0.00$ ).

## Alcohol and Risk-Taking

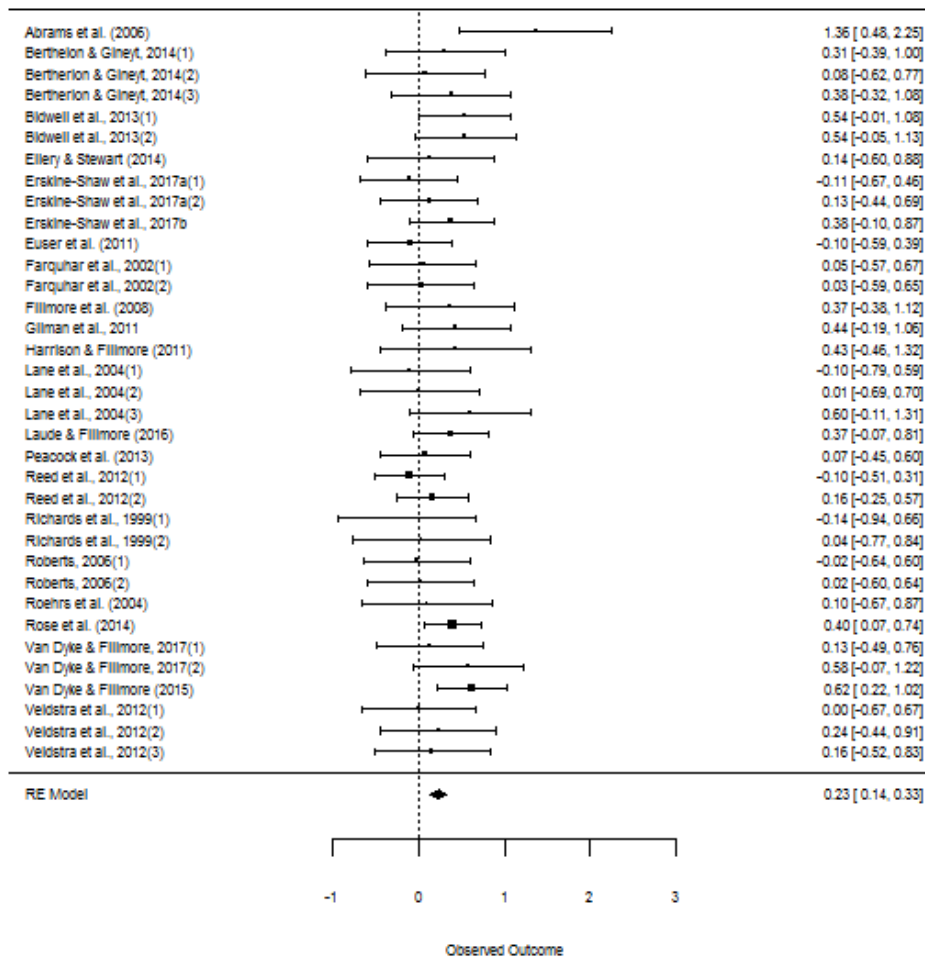


Figure 6.2 Forest Plot displaying effect sizes for selected studies on alcohol and risk-taking.

### Meta-analyses: separated by risk-taking measure

A random effects meta-analysis using restricted maximum likelihood was carried out for each risk-taking measure category: gambling, risky driving, and non-specific. An additional analysis was conducted on alcohol and risk-taking behaviour, using just the BART ( $k = 6$ ). See Figure 6.3 for forest plots of separate risk-taking measures.

**Gambling.** Overall, interactions measuring risk-taking behaviour via gambling ( $k = 10$ ) revealed a small effect of alcohol on risk-taking whereby alcohol consumption increased risky gambling behaviour,  $g = 0.34$ , 95% CI = 0.12, 0.57,  $p = .002$ . A small effect was found in one interaction (Gilman et al., 2012), a moderate effect in three (Bidwell et al., 2013; Lane et al., 2004), and a large effect in one (Abrams et al., 2006). The remaining five did not reveal an effect of alcohol on risky gambling.

**Driving.** A meta-analysis of 15 interactions also revealed an increase of risky driving following alcohol consumption,  $g = 0.28$ , 95% CI = 0.13, 0.44,  $p < .001$ , demonstrating a small effect of alcohol. Six interactions found a small effect in the hypothesised direction, and two revealed a moderate effect size. The remaining seven demonstrated negligible effects ( $g < 0.16$ ).

**Non-Specific.** Other, non-specific risk-taking measures were grouped into their own category ( $k = 9$ ). The BART was used in 66% of these interactions and therefore an additional meta-analysis was conducted with interactions using the BART ( $k = 6$ ). When risk-taking was measured using non-specific risk-taking tasks, alcohol was not found to affect risk-taking behaviour, compared to placebo,  $g = 0.10$ , 95% CI = -0.07, 0.26,  $p = 0.26$ . Analysis of interactions using only the BART also found no effect of alcohol on risk-taking behaviour,  $g = 0.10$ , 95% CI 9 -0.11, 0.30,  $p = 0.35$ . Only one interaction found an effect size above 0.20 in both analyses ( $g = 0.40$ ; Rose et al., 2014).

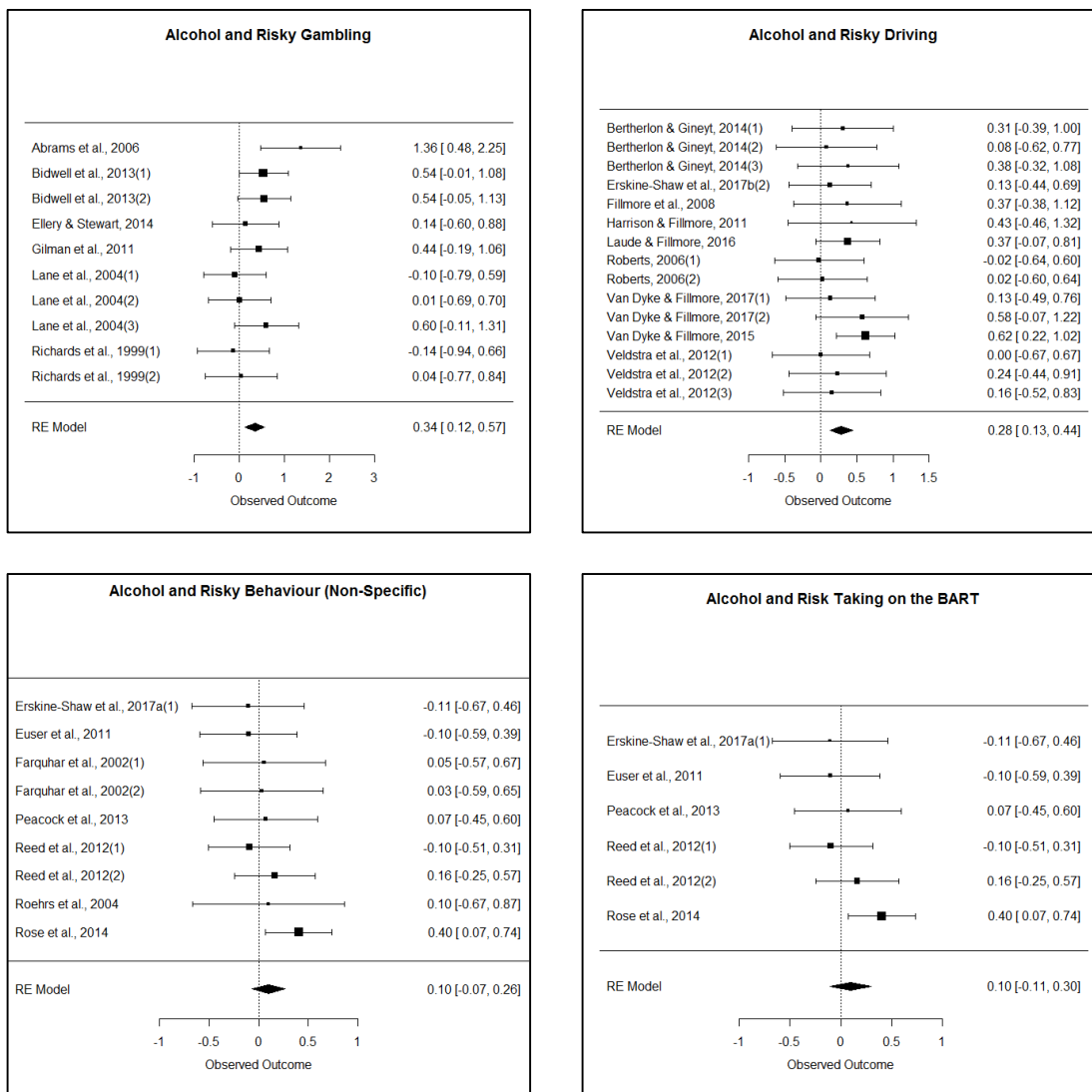
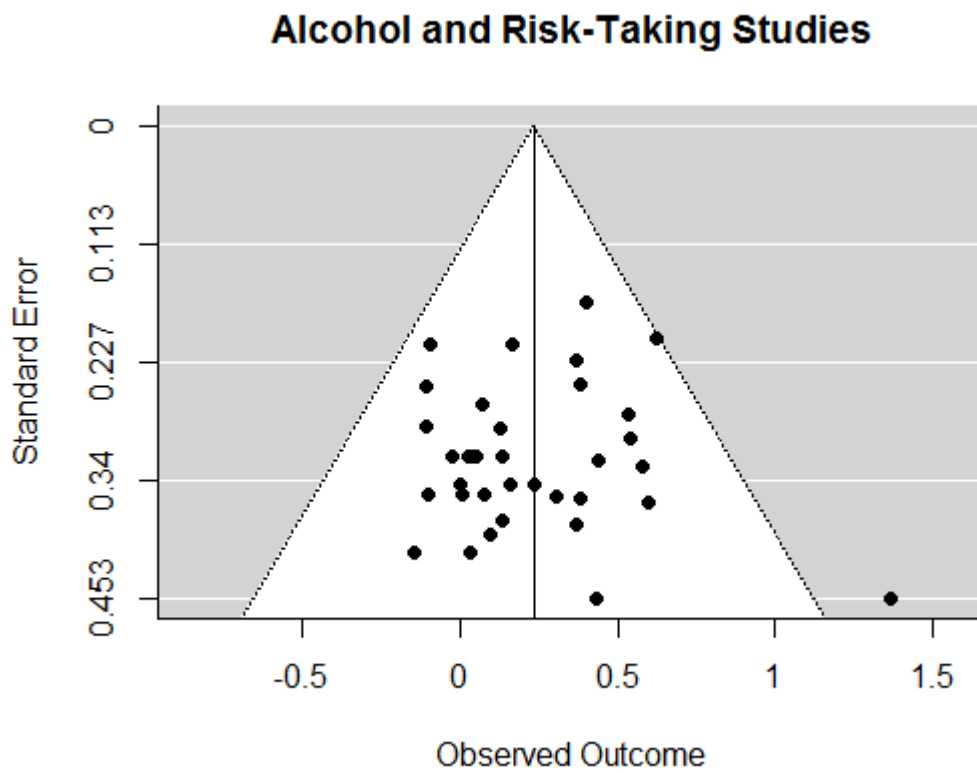


Figure 6.3 Forest Plots displaying effect sizes for selected studies, separated by risk-taking measure

### Publication bias

No publication bias was suggested via the funnel plot (see Figure 6.4). Further, Eggers weighted regression test did not reveal asymmetry across studies ( $z = -0.31, p = 0.75$ ).



*Figure 6.4* Funnel plot for selected alcohol administration studies measuring risk-taking.



## Discussion

Twenty-two studies (n = 778) containing 35 interactions were synthesised and analysed to investigate an overall effect size of alcohol (compared to placebo) on risk-taking behaviour. Meta-analysis highlighted a small significant effect of alcohol on subsequent risk-taking behaviour in comparison to a placebo dose. A small significant effect of alcohol on driving and gambling domains of risk was also revealed. Conversely, no effect of alcohol on more general, non-specific risk-taking was found.

The current meta-analysis is the first of its kind to quantitatively synthesise alcohol administration studies investigating risk-taking behaviour across a number of risk domains. The significant effect on alcohol on risk-taking overall (including all risk-taking measures) is comparable to similar meta-analyses examining only sexual risk-taking (Rehm et al., 2012; Scott-Sheldon et al., 2016). Highlighting a causal direction, the present work indicates risk-taking as a consequence of intoxication, although such effect did not be found to be linear, as risk-taking did not increase in line with higher BAC. Therefore, reducing the quantity of alcohol consumption opposed to complete abstinence may be ineffective in reducing engagement in risk-taking.

A further element to consider when evaluating the overall meta-analysis, is the breadth of risky behaviours examined. Studies comprised multiple measurements investigating both domain-specific risk-taking behaviour, such as risky driving and gambling, and more general risk-taking (for example, blowing up a balloon via a keyboard press to obtain points; BART). Sub-analyses of each risk domain (and non-specific risk-taking) revealed that alcohol had a small, but significant effect on driving and gambling

risk domains. It is reported that 13% of all road mortalities are a result of drink driving, demonstrating the importance of understanding alcohol's influence whilst driving. Although one's willingness to drive is suggested to decrease following alcohol consumption (Amlung et al., 2014), findings from the current meta-analysis highlight the role of alcohol on potentially harmful risky driving behaviours. Quantitative synthesis of existing studies further found alcohol consumption to increase risky gambling. Although gambling may not commonly be associated with physical harms, continued risky bets may result in severe financial, emotional and social harm (Clark, 2015). Consequently, identifying the role of alcohol in gambling behaviour may hold promise for future intervention efforts in reducing gambling-related harms. As such, the combined presence of both alcohol and gambling opportunities on the same premise may be a concern when attempting to decrease risky betting behaviour.

Contrary to the two risk domains examined, the current meta-analysis found that alcohol did not affect risk-taking when this was not measured under a specified domain (more general measures of risk-taking). The findings reveal some important considerations for both the influence of alcohol across varied domains of risk, and the way in which risky behaviours are identified and measured within experimental alcohol research. These findings suggest that alcohol's influence on specific risky behaviours were likely to be driving the effect found in the overall meta-analysis. Specifically, the current results suggest that it is necessary to select an appropriate measurement of risk, ensuring that it is comparable to the real life risky scenarios that may be associated with alcohol consumption. As an individual's perception and assessment of risk are largely defined within moral and social beliefs set by society (Arnoldi, 2009; Green, 1997), the element of

real risk may not be identified with non-specific risk-taking tasks, which are incomparable to real risky scenarios. The overall effect of alcohol on risk-taking behaviour (both specific and general) therefore reveals some important considerations for both the influence of alcohol on risky behaviours, and the way in which risky behaviours are identified and measured within experimental alcohol research

Research to date, and consequently the current meta-analysis, have not considered fully the social influences which are likely to contribute to alcohol-induced risk-taking (Sayette, Dimoff, et al., 2012). Here, only three eligible experimental studies ( $k = 4$ ) were identified for phase two of the review (the addition of a context comparator: group versus isolated). Consequently, the role of social influences on alcohol-related risk could not be quantitatively addressed within the current meta-analysis. It is also noteworthy that the three studies eligible for subsequent review and analysis present inconsistent findings. However, inconsistencies may be explained by differences in the way group influence was measured in the studies. Namely, risk-taking in Abrams et al. (2006) was measured via one collective decision per group, whereas Erskine-Shaw et al. (2017a; b) (Study 2 and 3 of the thesis) measured individual's risky behaviour while situated in a group. As such, the two studies together, would not be suitable for meta-analysis, as arguably they are examining different constructs (group decision making versus group influence on individual risk-taking). Consequently, future research into alcohol's effects on risky behaviour should be encouraged to address the possible added influences from social contexts.

It is important to note limitations of the current meta-analysis and encompassing studies, when considering the impact of the findings. Firstly, although an effect of alcohol

on risk-taking was found overall, and in specific risk domains, all effects were small. It is possible that such small effects were driven by the small sample sizes across many of the studies included in the current meta-analysis. For example, the average sample size is 26 for within participants, and 56 for between participant studies. Another important consideration of the current thesis is the range of effect sizes in comprising studies. Namely, the largest effect of alcohol on risk-taking behaviour revealed by Abrams et al. (2006) ( $g = 1.36$ ), does not appear to be representative of studies investigating this topic, as is illustrated in Figure 6.2. Although the amount administered in this particular study (1.13 g/kg) was higher than that dispensed in other studies, the mean BAC of participants was similar to other studies administering lower doses between .56-.8 g/kg. Due to the magnitude of this effect, and the variations between dose administered and observed BAC, analysis was also conducted excluding this interaction. Following removal, effect size did reduce, but a significant small effect of alcohol on risk-taking ( $g$  difference = -.01), and specifically gambling ( $g$  difference = -.06) was still revealed. As such, there is no reasonable rationale to exclude such findings, and therefore this study was used in the analysis.

In conclusion, the current meta-analysis of 22 studies ( $k = 35$ ) reveals a small, but significant effect of alcohol on risk-taking behaviour, and more specifically, risky drinking and gambling domains of risk-taking. Contrariwise, synthesis of studies measuring more general, non-specific risk-taking, did not illustrate an effect of alcohol consumption on risky behaviour. The meta-analysis therefore suggests that the consumption of alcohol is likely to increase risk-taking whilst driving and gambling. However, importantly it indicates that this effect is not present in risk-taking which is not characteristic of any

particular domain (general measures of risk), and that research must therefore be careful in the measures selected and the risk domains in which findings are generalised to.

Accordingly, intervention approaches would do well to account for the multi-dimensional nature of risk by targeting specific risk-taking domains opposed to risk-taking overall.

Finally, these analyses suggest that a paucity of research has considered the potentially important role of different social contexts on alcohol-related risk, and that the diminutive research in this area has produced inconsistent results. Further explorations in this domain are therefore strongly advisable.

### **Chapter Conclusions**

This penultimate chapter aimed to synthesise alcohol administration studies to identify the overall effect of alcohol on risky behaviour. Initially the chapter proposed to synthesise studies comprising comparators of isolation versus group contexts, however, due to the diminutive research investigating the combined role of alcohol and groups on risky behaviour, meta-analysis of the latter was not possible. The chapter concludes that alcohol has a small, yet significant effect on risk-taking behaviour, although this effect is not based on the level of intoxication (via BAC). The meta-analysis further supports former thesis chapters by identifying variations in the effect of alcohol across risk-taking domains, suggesting the importance in defining risk-taking domains and careful consideration when choosing risk-measures. The chapter offers new insight into the role of alcohol on risk-taking behaviour based on synthesis of existing data.

## Chapter 7 Overall Discussion and Conclusions

Much formative research has identified associations between risk-taking and alcohol consumption (Courtney et al., 2012; Proestakis et al., 2013), however the direction of causality has been unclear, as risk-taking may act as a determinant, or consequence of alcohol use (de Wit, 2008). In view of this, and the dearth of research examining social and contextual influences on alcohol induced risk-taking (c.f., Abrams et al., 2006; Hothrow et al., 2014; Sayette, Dimoff, et al., 2012), the current thesis aimed to experimentally examine (i) the role of trait risk-taking in predicting alcohol consumption behaviours, (ii) the independent and combined influences of alcohol and groups on risk-taking, and (iii) the impact natural social drinking environments on risky behaviour. The thesis further aimed to examine such relationships across varying risk-taking domains and measures.

In sum, this thesis contributes three-fold. First, an original contribution to the literature is made by expanding the present understanding of how groups and alcohol independently, and combined, influence individual risky behaviour both in a laboratory (Studies 2 and 3), and in natural social environments (Study 4). Secondly, across all studies, and via quantitative synthesis of the literature in the meta-analysis (Chapter 6), the thesis provides new insight into the effects of social and isolated drinking across various domains of risk-taking behaviour including: risky driving, gambling, physical risk-taking, and more general (not domain-specific) risk-taking. Moreover, in this regard, the thesis contributes to the methodological repertoire of risk-taking measures by presenting a novel physical risk-taking measure, akin to real world drinking games. Finally, the thesis provides new insight into the role of risk-taking in predicting alcohol consumption behaviours.

## Summary of Findings

### **Risk-taking as a *determinant* of alcohol use**

**Study 1 (Chapter 2).** Study one utilised an online survey to examine the predictive utility of both self-reported risk-taking propensity and impulsiveness independently, and combined, on various alcohol consumption behaviours. Furthermore, recognising these predictors as multi-faceted constructs, the association of sub-traits of impulsivity and risk with alcohol use behaviours was investigated. Results revealed trait impulsivity and risk-taking as potential risk-factors for AUDIT-defined hazardous and harmful drinking and dependence symptoms, with 10-14% of variances in alcohol use explained by the personality traits combined, and 8-11% independently. Findings further suggested variations in sub-traits of risk-taking and impulsiveness, whereby sub-traits predicted different types of alcohol consumption behaviour highlighting the importance of addressing these constructs as multi-faceted when designing personalised interventions. Finally, although impulsivity and risk-taking were found to be non-synonymous constructs, some overlap between the two was also identified. Although some understanding of risk-taking may be offered through examining impulsiveness, it was argued that this knowledge may be limited in elucidating non-impulsive risky behaviours.

### **Risk-taking as a consequence of social drinking**

**Study 2 (Chapter 3).** Study 2 aimed to investigate the independent and combined effects of 0.6g/kg of alcohol (compared to placebo) and group contexts (compared to isolation) on individual risk-taking across two behavioural tasks (risky driving and non-domain-specific). Findings suggested that being in a group enhances individual's risk-

taking behaviour, regardless of whether alcohol or placebo had been consumed, whereas alcohol did not increase risky behaviour on the tasks. Furthermore, placebo reduced risky behaviour on only the risky driving task, possibly due to compensatory responding from anticipated effects of alcohol. It was argued that the absence of such finding following alcohol consumption supports alcohol myopia model explanations of alcohol-induced deficits in systematic evaluation whereby alcohol narrows attention leading to impairments in systematic evaluation. Consequently, risky behaviour before consumption may not be considered and therefore, risk-taking is not altered post-beverage. Moreover, the absence of compensatory responding on the general risk task (balloon analogue risk task; BART) may, be a consequence of socially and culturally constructed perceptions of risk (Arnoldi, 2009; Green, 1997), whereby drink-driving may appear more immoral or dangerous than inflating a balloon. As such, behaviour on the driving task is more likely to be evaluated in light of alcohol consequences. The differences between the two tasks highlight an important consideration for future research to address the type of risk-measures used and effectiveness of findings in generalising to alcohol-related risks.

**Study 3 (Chapter 4).** The aim of Study 3 was to investigate the effects of an increased dose of 0.8g/kg of alcohol (to better represent the number of units constituting a binge episode) and group context on physical risk-taking behaviour, and to examine the possible mediating effects of mood. To measure risk-taking a novel risk measure was developed, more akin to real world drinking games: The Shuffleboard Game. Results found both alcohol and groups to independently increase risk-taking. Yet, results indicate that social settings and alcohol do not interact to influence risky behaviour to a varying extent, and thereby suggest that these influences may operate independent from each other. Study 3



also supports the importance of affective state on risky behaviour by suggesting that the more positive one feels, the more likely they are to engage in risky behaviour. The study also points to groups influences on affective state, through enhanced mood. The findings however indicated that group influence on risky behaviour is not mediated by changes in affective state. Results emphasise the importance of considering (independently) the social and alcohol effects, and influence of one's emotional state on risky behaviours

**Meta-analysis (Chapter 6).** Chapter 6 presents a quantitative synthesis of experimental alcohol administration studies investigating the effects of alcohol on risk-taking behaviour, overall and dependent on risk-taking domain. Furthermore, the meta-analysis synthesised studies incorporating comparative variables of isolated and group contexts in this regard. However, a systematic literature search revealed only three eligible articles for the latter and therefore a meta-analysis was only conducted on those investigating alcohol and risk-taking behaviour. This analysis indicated that the effect of alcohol on risk-taking behaviour was small, yet significant. Comparable to this, driving and gambling risk-domains were also found to be influenced by intoxication, whereas risk-taking on non-domain-specific measures was not affected by alcohol consumption. Overall, the meta-analysis supports the notion that alcohol heightens risky driving and gambling behaviours, in particular. Moreover, findings outline the variations between risk-taking domains, and highlights the need for caution when measuring risk-taking more generally.

## **Risk-taking in the wild**

**Study 4 (Chapter 5).** This experimental field study examined the impact of social environment, intoxication level and group size on lottery risk-taking behaviour and perceived risk-related injunctive norms. Lottery risk-taking was not found to differ between alcohol or non-alcohol related social environments and was not associated with intoxication alluding to potential residing influences of social contexts, in the absence of alcohol (as per Studies 2 and 3). However, findings did indicate that being in an alcohol-related environment enhances people's beliefs that peers will approve of risky alcohol consequences, suggesting injunctive norms to be somewhat context-dependent. Results further suggest that larger group size was associated with increased lottery risk-taking in non-alcohol-related environments only. It was argued that this finding may offer some support towards alcohol myopia model explanations of focal narrowing when intoxicated (as less attention is given to group size). Finally, perceived injunctive norms were found to be associated with self-reported engagement in risky alcohol consequences, emphasising the impact of potentially misperceived norms on harmful behaviours.

## **Limitations and Future Direction**

Prior to considering the overall conclusions of the thesis, it is necessary to note limitations of the studies included in this thesis overall with a view to informing possible fruitful avenues for future research. As potential issues and limitations of the specific studies have been addressed in the relevant chapter discussions, the following section provides further thoughts on the empirical parts of this thesis overall.

### **Student samples**

The majority of studies included in this thesis consist of student samples. Recruitment of student participants is often favoured due to their enhanced accessibility, in addition to time and cost-effectiveness benefits (Druckman & Kam, 2011; Payne & Chappell, 2008). There are also further benefits to the use of student samples, including higher homogeneity in samples (Druckman & Kam, 2011) and the prevalence of risky behaviour in such populations (Dorsey, Scherer, & Real, 1999; Rolison & Scherman, 2003; Tomaso et al., 2015; Zamboanga et al., 2011). Here, homogenous samples are less likely to be affected by confounding and extraneous variables (Druckman & Kam, 2011), and the ability to effectively generalise back to such specific samples may hold promise in reducing university harmful drinking practices (Demerouti & Rispens, 2014). Nevertheless, the use of this population raises some potential concerns.

The external validity of research from student samples is debated, and some believe that findings are not able to be extrapolated to behaviours of the general public (Druckman & Kam, 2011; Gainsbury & Blaszczynski, 2011; Peterson, 2001). Indeed, a second order

meta-analysis further supports the distinction between student and non-student samples, with findings indicating that participants are more homogenous in student samples and therefore lack the diversity seen in the general public (Peterson, 2001). Furthermore, this analysis suggested variability in direction and magnitude of the effects observed between student and non-student studies.

The unique drinking practices and experiences of student populations also constitute reasons for which researchers should be cautious when looking to apply their findings – and those contained within this thesis - to wider populations. Alcohol consumption is generally found to be greater among college/university students than that typically observed in other groups (O'Malley & Johnston, 2002; Santos Jr. et al., 2014; Tzilos, Caviness, Anderson, & Stein, 2016; Wicki, Kuntsche, & Gmel, 2010). Those who attend university also appear less likely to display alcohol use problems than other groups, as students frequently 'mature out' of the heavy drinking patterns (Littlefield, Sher, & Wood, 2009). These characteristics present issues when attempting to generalise more widely to non-student populations. As such, care should be taken when seeking to generalise findings from the current thesis to non-student samples who may engage in different drinking practices with conceivable differences with regards to their performance on tasks utilised in the current thesis (e.g., the shuffleboard game in study three) (Tomaso et al., 2015; Zamboanga et al., 2014)

Finally, demographic variations between students and non-students may affect risk taking and alcohol consumption practices as a whole. For example, independent of student status, being away from parental supervision (Buddie & Testa, 2005) is associated with

increasing levels of alcohol consumption (Evans-Polce, Maggs, Staff, & Lanza, 2017; Littlefield et al., 2009), and experiences of risky sexual situations (Buddie & Testa, 2005). The way in which findings from student populations are generalised is therefore an important consideration for this thesis, and caution must be taken when attempting to generalise findings the thesis studies to wider populations.

### **Risk-taking measures: what is risky?**

As noted throughout this thesis, risk-taking behaviour is a multi-faceted concept comprising a number of traits (e.g., impulsivity and sensation seeking) and domains (e.g., social, financial, ethical, etc.). This is reflected in the many risk-taking methods utilised by researchers (c.f., Dohmen et al., 2011), such as choice dilemmas (Kogan & Wallach, 1964), computerised behavioural and gambling tasks (Lane & Cherek, 2000; Lejuez et al., 2002), and driving simulators (Weafer & Fillmore, 2012a). An assortment of measures was used in the current thesis to capture risk-taking across varying domains, however, as with other tasks, these have limits of their own (which were discussed earlier in the relevant chapters). More importantly however, as different measures assess varying domains of risk, care must be taken when seeking to generalise the current research to all types of risk-taking. Indeed, as noted in the meta-analysis, previous inconsistencies in this area of research may be explained by variability between the risk measures used. This thesis therefore advocates the importance of identifying the domain in which the risk behaviour resides, and taking caution when applying such findings to other areas of risk-taking which may be less representative of that measured.

More generally, the capacity to examine real-world potentially harmful risk-taking behaviour is limited due to ethical constraints, as morally, researchers cannot place participants in a risky situation which could lead to harm or distress (The British Psychological Society, 2014). This therefore presents a limitation which must be accepted of any experimental examinations of risk taking, including those in the current thesis. In an attempt to measure risk-taking more akin to real-world drinking-related behaviours, whilst also abiding by ethical confines, Study 3 developed the Shuffleboard Game. The game aimed to mimic drinking games capturing an element of risky behaviour, due to the prevalence of drinking games in student alcohol use (Tomaso et al., 2015; Zamboanga et al., 2014). Although such drinking games rarely offer monetary reward, the use of points or hypothetical monetary rewards in tasks used in the thesis may reduce the perception of risk (Xu et al., 2016). As such, careful consideration of such factors is necessary when attempting to generalise findings from such tasks.

Alternatively, using self-report measures where participants can retrospectively report previous risky behaviour represents one way of circumventing such ethical constraints. However, these too present an important limitation regarding socially desirable responding and the ability to accurately recall (and judge) one's own behaviour (Lane et al., 2003). Consequently, it is recommended that self-reports be used in conjunction with behavioural measures, which may provide a broader picture of actual risk-taking and believed engagement in risk (Collado, MacPherson, Kurdziel, Rosenberg, & Lejuez, 2014). In sum, although the thesis offers findings from a range of risk-taking measures; both questionnaires and behavioural tasks, it is important that these are extrapolated to discussion of real-world risky behaviours relative to the risk domains measured.

## **Alcohol administration protocol**

Finally, it should be noted that the current thesis used alcohol administration procedures which included only alcoholic or placebo beverage conditions, in line with other research in this area (Abrams et al., 2006; Rose et al., 2014). However, a pure control condition where alcohol is neither given or expected, was not incorporated. As such only actual alcohol consumption and belief of intoxication (without alcohol consumption) could be compared.

Moss and Albery (2009) posit a dual process model of the alcohol-behaviour link, whereby both the anticipated (expectancies) and pharmacological (processing capacity) effects of alcohol are surmised to impact behaviour. They argue that the alcohol-behaviour link is one which incorporates not just alcohol's pharmacological effects on behaviour, but also considers how alcohol-related cognitions may impact behaviour. In other words, it is suggested that alcohol consumption may, at times, be associated with behaviour change not through intoxication itself but via beliefs and expectancies regarding the effects of intoxication. As such, anticipated effects from consuming an alcohol placebo resulting in behavioural changes may be observed (in line with perceived normative attitudes and behaviour), that are akin to those that may be expected when alcohol is actually consumed (Christiansen et al., 2017). Indeed, in support of this contention, recent research has found placebo alcohol to increase craving, *ad libitum* alcohol consumption, subjective intoxication (Christiansen et al., 2017), disinhibition, and indirectly, outcome expectancies (Christiansen et al., 2016).

With the above in mind, it is important to note that Studies 2 and 3 may have elicited anticipated effects of alcohol consumption in the placebo conditions. Indeed, this may explain findings from Study 2 indicating that risky driving behaviour reduces following placebo. The belief that alcohol has been consumed in the placebo condition may consequently result in anticipatory responding, as participants attempt to counteract believed impairments associated with alcohol which, in this case, would be increased risk-taking. Consequently, the absence of a pure soft drink control renders it difficult to fully separate out the anticipated from the pharmacological effects of alcohol on risk taking within social contexts. Future research would therefore benefit from the use of a pure control, in addition to alcohol and placebo conditions in order to unpick these effects.



## **Research and Intervention Implications**

The findings of this thesis have implications for ongoing research in this field, as well as possibly for the development of interventions to target harmful risky behaviours in drinking environments. By highlighting these implications, the thesis hopes to encourage continued development within this area.

### **Contribution to research knowledge**

As identified in the meta-analysis (Chapter 6), limited research has experimentally manipulated beverage and social context simultaneously, to examine both the independent and combined effects of alcohol and social groups on risky behaviour. What is more, previous work in this regard has examined group influence via a collective group decision around risk, as opposed to the effect of group contexts on individual risky behaviour (e.g., Abrams et al., 2006; Sayette, Dimoff, et al., 2012). To this end, the thesis offers an original contribution to our knowledge in this area. Specifically, it is the first to examine experimentally both the combined and independent influences of an acute dose of alcohol, and group context on *individual* (as opposed to collective group) risk-taking. In doing so, the thesis findings suggest that being in the presence of others is enough to enhance one's engagement in risk (see Studies 2 and 3), highlighting the power of social settings to impact alcohol behaviours regardless of intoxication. Here, a more nuanced understanding of the importance of group contexts in alcohol consumption and individual risk-taking behaviour is offered. Moreover, the thesis supports both the role of risk-related injunctive norms on people's risky behaviour, in addition to the context-dependent nature of such norms. To this end the thesis identifies important avenues for future research investigating the role of

social norms, whereby consideration of the contexts in which norms are examined, may influence the relationships captured.

This thesis also provides important methodological considerations for ongoing research in this domain. First, it suggests that research in this area should strive to assess risk taking in contexts akin to real-world drinking environments. In this regard, the development of a novel risk measure in Study 3, presents a potential avenue for future risk-taking measurement design, due to its physical nature and similarity to real-world drinking games (Tomaso et al., 2015; Zamboanga et al., 2014). Second, findings highlight the variability across risk-taking measures via quantitative synthesis of previous work, and through the utilisation of gambling, driving, physical and non-domain specific risk-measures in Studies 2 to 5. As such, the current thesis highlights how different measures may predict, and be affected by alcohol use to varying extents, and consequently, future research designs should take caution when selecting risk-taking measures whilst being mindful of the types of risk the study wishes to generalise findings to.

### **Contribution to intervention**

Intervention efforts may also benefit from consideration of findings presented in the current thesis. Study 2 and 3 supported the importance of targeting not only alcohol consumption, but also contexts in which harmful alcohol behaviours occur. As identified in Chapter 1, recent statistics point to a reduction in alcohol consumption over recent years (HSCIC, 2017), however this does not appear to be mirrored in an associated decrease in alcohol-related harms (such as risk-related injuries; Taylor et al., 2010). Studies 2 to 4,

may offer some insight in this regard, and aid current intervention efforts in reducing alcohol-related risk. More specifically, social settings were found to increase general and driving-related risk taking in Study 2, and physical risk-taking behaviour in Study 3, regardless of alcohol. Moreover, in Study 4, gambling type risk did not differ between alcohol and non-alcohol related social setting, suggesting that in the absence of alcohol, social influences on risky behaviour may still reside, and may undermine interventions aimed solely at reducing alcohol use. Study 4 also found that individual alcohol-related risk-behaviour aligned with related perceived injunctive norms, identifying a potential target for combatting harmful social influences. In this regard, previous work has supported the use of normative feedback interventions (Carey et al., 2007; Dotson et al., 2015; Goode et al., 2014), whereby informing individuals of real (opposed to misperceived) norms may reduce alcohol consumption. Identifying the association of specifically, perceived alcohol-related risk norms and experienced behaviour in Study 4 therefore highlights this as potential intervention avenue to reduce risky drinking. Moving forward, combatting both excessive alcohol use and the influence of others may be more fruitful in reducing risky behaviours in social drinking settings.

Finally, the recognition of both dispositions towards risk, and trait impulsivity in predicting alcohol use behaviours (Study 1), illuminates possible factors to be addressed in reducing harmful and hazardous alcohol use, and dependency symptoms as measured by the AUDIT. The thesis further offers some understanding of the multi-faceted nature of these predictors, and thereby supports the importance of addressing risk-factors as multi-dimensional. Although an individual may not demonstrate a disposition for ‘general’ risk-behaviours, it can be suggested that, their assessment of risks may determine alcohol use

behaviours symptomatic of dependency. As such, careful consideration is warranted in efforts to prevent and treat problematic consumption.

## Conclusions

The thesis explored systematically risk-taking as both a determinant, and as a consequence of alcohol consumption. Moreover, by building on previous investigations, the aim of the thesis was to examine the effects of alcohol in settings more akin to real-world drinking than had been undertaken previously. As such, studies explored the independent and combined influence of social contexts and alcohol consumption across a variety of risk-taking domains.

Previously overlooked social factors were found to consistently influence risk-taking, independent of alcohol and, at times, in the absence of any intoxication effects. The thesis therefore illustrates the significance of such social influences as a leading contributory factor to engagement in risky behaviours. Indeed, both Studies 2 and 3 found being in the presence of others to significantly increase risk-taking on general, driving, and physical measures of risk, identifying such effects across a variety of risk domains. Furthermore, in natural (non-alcohol-related) social environments, being part of larger groups appeared to predict riskier gambles (Study 4). The findings highlight not only the impact of groups on risky behaviour more generally, but also the varying impact of different sized groups, suggesting that social influences may be exaggerated or reduced dependent on the number of peers present.

Importantly, the meta-analysis identified a paucity of research considering such influences in this area, which is important to consider whilst being mindful of the social influences identified in empirical studies included in this thesis. In this regard, the thesis

findings highlight the importance in taking caution when generalising findings from isolated laboratory contexts to real world drinking behaviours, where social influences may be present. It is therefore possible to suggest that research efforts would benefit from examining such social influences when investigating behaviour often presented in social environments. Considering the effects of alcohol and social contexts on risky behaviour, the thesis further offers insight into the potential limits of current intervention efforts. As Studies 2 and 3 found alcohol and/or social influences to enhance risk-taking behaviour independently (not in combination of alcohol), this may point to residing social influences, when tackling alcohol consumption to reduce potentially harmful risky behaviours. As such, it is important for future intervention efforts to address the impact of social influences alongside alcohol consumption. Correspondingly, intervention efforts may also benefit from addressing individual's perception of peer's approval of such risky behaviours (as identified in Study 4).

In addition to social influence, the thesis contributes an enhanced understanding of the varying effects of alcohol across several risk-taking domains. Although alcohol's effect of risky behaviour is identified both anecdotally and within research '*it was the drink that made me do it*', findings from Studies 2 to 4, and the meta-analysis, suggest that alcohol's effect on risk-taking is not consistent across all risk domains. As such, findings highlight the importance for future research to heed caution in identifying risk-taking measurement for specific risk domains, and to carefully consider the generalisability of findings to varying types of real world risk behaviours. For example, findings from non-domain-specific risk-taking tasks may be limited in their representation of risky driving when intoxicated. Moreover, the thesis contributes a novel measure of physical risk-taking, more

akin to real world drinking games: The Shuffleboard Game. As such, generalisability of such findings to student populations may offer fruitful consideration for research and practice.

Finally, with an aim to also assess risk-taking as a determinant of alcohol consumption in Study 1 the thesis offers some insights into both risk-taking and impulsivity as potential risk-factors to alcohol consumption behaviours. In this regard, it is important to note that although the thesis found impulsiveness and risk-taking to overlap somewhat, these constructs account for distinct variances in alcohol use behaviour. It is therefore also advisable to consider non-impulsive risk-taking traits, and risk assessment as potential antecedents to problematic alcohol use.

In sum, the thesis supports the role of risk-taking propensity in predicting a variety of AUDIT-based alcohol consumption behaviours, whilst further supporting the need for careful consideration when measuring and representing risk-taking as a multi-faceted construct. More prominently, the thesis highlights an important area of consideration for future alcohol-related research. By investigating the combined and independent effects of alcohol and social context on risky behaviours, studies in this thesis found social influences to be an important factor contributing to risk-taking that was consistent across all risk domains assessed. Furthermore, findings indicate that intoxication effects are contingent on the different risk domains in which these effects are recorded, and on the measures employed. As such, findings identify a fruitful avenue for future research and interventions aiming to better understand, and reduce, potentially harmful risky behaviours in social

drinking settings. Importantly, findings do not downplay the role of alcohol on risky behaviour, but rather, demonstrate the important contributory social influences which to this point, have largely been overlooked.



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# Appendices

## Appendix A: Medical screening

### Medical Screening

1. Are you currently under the regular care of a physician aside from routine or regular checkups?

Yes       No

If YES, for what condition?

2. Are you currently taking any medications on a regular basis?

Yes       No

If YES, what medications?

3. Have you ever had:

- |   |                              |                             |
|---|------------------------------|-----------------------------|
| a) a heart attack or stroke?                        | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| b) any indication of heart trouble?                 | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| c) high blood pressure?                             | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| d) diabetes?  | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| e) liver disease?                                   | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| f) any psychiatric illness?                         | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| g) neurological disorders, such as epilepsy?        | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| h) gastrointestinal problems, such as peptic ulcer? | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| i) pancreatitis?                                    | <input type="checkbox"/> Yes | <input type="checkbox"/> No |

4. In terms of your use and reactions to alcoholic beverages, have you had:

- |  |                              |                             |
|--|------------------------------|-----------------------------|
| a) an experience of fainting or a seizure<br>after drinking alcohol? | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
|--|------------------------------|-----------------------------|

b) unusual flushing of your skin?

Yes

No

c) problems with your liver?

Yes

No

d) severe or unusual psychological  
reactions to alcohol?

Yes

No

5. In terms of your history of alcohol use, have you ever:

- a) been seriously concerned about the extent or amount of your drinking?  Yes  No
- b) been treated or advised to seek treatment for a drinking problem?  Yes  No
- c) been told by a professional person that you are is or might be an alcoholic?  Yes  No

6. In terms of your family's history of alcohol use, has anyone in your immediate family, that is, mother, father, sister, or brother:

- a) been seriously concerned about the extent or amount of his or her drinking?  Yes  No
- b) been treated or advised to seek treatment for a drinking problem?  Yes  No
- c) been told by a professional person that he or she is or might be an alcoholic?  Yes  No

### Medications

7. Are you currently taking any of the following prescription medications?

- insulin or other drugs used to control **diabetes** ? [such as chlorpropamide (Diabinese), metformin (Glucophage), phenformin, or tolbutamide (Orinase) ]
- MAO inhibitors? [such as isocarboxazid (Marplan) or phenelzine (Nardil) ]
- Antabuse, also called disulfiram?
- ketoconazole, which is an anti-fungal?
- flagyl, which is an antibiotic?
- drugs used to control **blood pressure** ? [such as nifedipine or verapamil]
- drugs used for **autoimmune disorders** ? [such as methotrexate or procarbazine (Matulane) ]
- benzodiazepines, like Valium or Librium?
- prescription pain medications?
- NOT TAKING ANY OF ABOVE MEDICATIONS

Please look over the answers you gave to the questions about your medical background and drinking habits. If any have been recorded incorrectly, please discuss with the experimenter.

We would also like you to agree that if you are given alcohol today, you will not leave the lab until your breath alcohol concentration (BrAC) is below 0.14mg/l. When your BrAC has fallen below .14mg/l, you may leave as long as you agree not to drive.

If you wish to voluntarily leave before your BrAC has reached this threshold, you must agree to sign a disclaimer.

If the information is all correct, and you agree to these conditions, please sign and date below.

Name:

Signed:











Date:

**Appendix B: AUDIT (Saunders, Aasland, Babor, De La Fuente, & Grant, 1993)**

**Alcohol Use Disorders Identification Test (AUDIT)**

For each of the following questions, please indicate the answer that applies to you.

Please note the units of alcohol typically contained in the drinks below:

1 UNIT	1.5 UNITS	2 UNITS	3 UNITS	9 UNITS	30 UNITS
 Normal beer half pint (284ml) 4%	 Small glass of wine (125ml) 12.5%	 Strong beer half pint (284ml) 6.5%	 Strong beer Large bottle/can (440ml) 6.5%	 Bottle of wine (750ml) 12.5%	 Bottle of spirits (750ml) 40%
 Single spirit shot (25ml) 40%	 Alcopops bottle (275ml) 5.5%	 Normal beer Large bottle/can (440ml) 4.5%	 Large glass of wine (250ml) 12.5%	Source: ONS, NHS	

1. How often do you have a drink containing alcohol?

- Never     
  Monthly or less     
  2-4 times a month     
  2-3 times a week     
  4 or more times a week

2. How many units of alcohol do you drink on a typical day when you are drinking?  
(Refer to top of page for definition of units)

- 1 or 2     
  3 or 4     
  5 or 6     
  7, 8 or 9     
  10 or more

3. How often do you have six or more units of alcohol on one occasion? (Refer to top of page for definition of units)

- Never     
  Less than monthly     
  Monthly     
  Weekly     
  Daily, or almost daily

**4.** How often during the last year have you found that you were not able to stop drinking once you had started?

- Never       Less than monthly       Monthly       Weekly       Daily, or almost daily

**5.** How often during the last year have you failed to do what was normally expected from you because of drinking? (e.g., missed meeting/ class/ event, didn't do a task, etc.)

- Never       Less than monthly       Monthly       Weekly       Daily, or almost daily

**6.** How often during the last year have you needed a first alcoholic drink in the morning to get yourself going after a heavy drinking session?

- Never       Less than monthly       Monthly       Weekly       Daily, or almost daily

**7.** How often during the last year have you had a feeling of guilt or remorse after drinking?

- Never       Less than monthly       Monthly       Weekly       Daily, or almost daily

**8.** How often during the last year have you been unable to remember what happened the night before because you had been drinking?

- Never       Less than monthly       Monthly       Weekly       Daily, or almost daily

**9.** Have you or someone else been injured as a result of your drinking?

- No       Yes, but not in the last year       Yes during the last year

**10.** Has a relative or friend or doctor or another health worker expressed concern about your drinking or suggested you cut down?

- No       Yes, but not in the last year       Yes during the last year





**Appendix C: BIS-11 (Patton, Stanford, & Barratt, 1995)**

DIRECTIONS: People differ in the ways they act and think in different situations. This is a test to measure some of the ways in which you act and think. Read each statement and put an X on the appropriate circle on the right side of this page. Do not spend too much time on any statement. Answer quickly and honestly.

                                                                   
 Rarely/Never    Occasionally                      Often                      Almost Always/Always

1	I plan tasks carefully.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	I do things without thinking.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	I make-up my mind quickly.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	I am happy-go-lucky.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	I don't "pay attention."	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	I have "racing" thoughts.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7	I plan trips well ahead of time.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8	I am self controlled.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9	I concentrate easily.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10	I save regularly.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11	I "squirm" at plays or lectures.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12	I am a careful thinker.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13	I plan for job security.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14	I say things without thinking.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15	I like to think about complex problems.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16	I change jobs.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17	I act "on impulse."	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18	I get easily bored when solving thought problems.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19	I act on the spur of the moment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20	I am a steady thinker.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21	I change residences.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22	I buy things on impulse.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23	I can only think about one thing at a time.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24	I change hobbies.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
25	I spend or charge more than I earn.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
26	I often have extraneous thoughts when thinking.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
27	I am more interested in the present than the future.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
28	I am restless at the theater or lectures.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
29	I like puzzles.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
30	I am future oriented.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Appendix D: RT-18 (de Haan et al., 2011)

Listed below are some questions. Please select the answer which most applies to you,

YES NO

- 1 Do you often get into a jam because you do things without thinking?
- 2 Do you usually think carefully before you do anything?
- 3 Do you mostly speak before thinking things out?
- 4 Do you enjoy taking risks?
- 5 Would you enjoy parachute jumping?
- 6 Do you welcome new and exciting experiences and sensations, even if they are a little frightening and unconventional?
- 7 I often try new things just for fun or thrills, even if most people think it's a waste of time
- 8 I often spend money until I run out of cash or get into debt from using too much credit
- 9 I like to think about things for a long time before I make a decision
- 10 I usually think about all the facts in detail before I make a decision
- 11 I enjoy saving money more than spending it on entertainment and thrills
- 12 I often follow my instincts, hunches, or intuition without thinking through all the details
- 13 I often do things on impulse
- 14 I enjoy getting into new situations where you can't predict how things will turn out
- 15 I sometimes like to do things which are a little frightening
- 16 I sometime do 'crazy' things just for fun
- 17 I prefer friends who are excitingly unpredictable
- 18 I like 'wild' uninhibited parties

## Appendix E: Mood and subjective intoxication scale

Please indicate how you feel right now by placing a vertical line along the scale between NOT AT ALL and EXTREMELY.

I feel happy

NOT AT ALL |-----| EXTREMELY

I feel grouchy

NOT AT ALL |-----| EXTREMELY

I feel fed up

NOT AT ALL |-----| EXTREMELY

I feel content

NOT AT ALL |-----| EXTREMELY

I feel sad

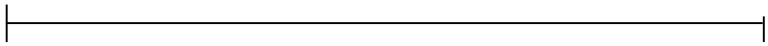
NOT AT ALL |-----| EXTREMELY

I feel good

NOT AT ALL |-----| EXTREMELY

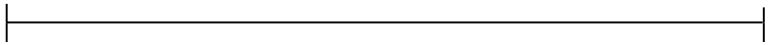
I feel drunk

NOT AT ALL EXTREMELY



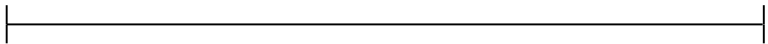
I feel dizzy

NOT AT ALL EXTREMELY



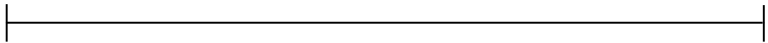
I feel clearheaded

NOT AT ALL EXTREMELY



I feel able to concentrate

NOT AT ALL EXTREMELY



**Appendix F: Risk-taking: YAACQ (Read, Kahler, Strong, & Colder, 2006) with  
injunctive norm measure**

Below is a list of things that sometimes happen to people during or after drinking alcohol. I would like you to mark an 'X' in the YES or NO column to indicate whether each item describes something which has happened **to you in the past month**

		NO	YES
1	I have driven a car when I knew I had too much to drink to drive safely		
2	I have taken foolish risks when I have been drinking		
3	I have gotten into physical fights because of my drinking		
4	I have damaged property or done something disruptive such as setting off a false fire alarm, or other things like that after I have been drinking		
5	My drinking has gotten me into sexual situation which I later regretted		
6	When drinking I have done impulsive things that I regret later		
7	I have injured someone else while drinking or intoxicated		

Next to each item please mark whether **your friends** would find these behaviours acceptable.

		NO	YES
1	Driving a car when knowing you have had too much to drink to drive safely		
2	Taking foolish risks when drinking		
3	Getting into physical fights because of drinking		
4	Damaging property or doing something disruptive after drinking		
5	Getting into sexual situations which you later regret		
6	Doing impulsive things which you later regret		
7	Injuring someone else because of drinking		

## Appendix G: Disclaimer for dismissal with BAC > .14 mg/l

Alcohol Disclaimer

Name of study participant:

Name of researcher:

I agree that prior to participating in the current psychology experiment, I was given an overview of the experiment with an explanation of the drinks I may be asked to consume (including alcoholic drinks). I was also told that, if given alcohol, I would be requested to stay in the laboratory (even after testing had finished) until my breath alcohol concentration has reached 0.14mg/l or below. This request is to help prevent any possible adverse effects from the drinks consumed during the experiment and is an ethical requirement of the research.

I have decided to voluntarily leave the vicinity early.

I will not hold the researcher, the Edge Hill University, or any Edge Hill University employee responsible for any accident or adverse incident that may occur to me if I decide to leave the laboratory before my breath alcohol levels are 0.14mg/l or below.

I confirm that I am not experiencing any potentially negative effects of having consumed alcohol.

Even though I am leaving, I know that I must not drive, ride a bike, operate machinery, or exercise for at least 4-5 hours.

Participant Signature:

Researcher Signature:

Date:

Time:

## Appendix H: Study 5 additional analysis

### Risk-Taking and Context

The 67 participants tested in the SU bar were separated into two conditions: alcohol consumed ( $N = 51$ ) and no alcohol consumed ( $N = 16$ ). A one-way ANOVA was then conducted to examine the effect of context (communal hub vs. SU bar - alcohol consumed vs. SU bar - no alcohol consumed) on risk-taking behaviour via the lottery task. There was no significant effect of context on risk-taking behaviour,  $F(2,135) = .53, p = .59$ .