Risky Drinking Behaviours Among Young People: An Investigation of Drinking Motives and Situational Factors

By

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BPsych (Hons)

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Dedication

This dissertation is dedicated to James and my parents; without your unwavering support throughout this journey, this PhD would not have come to fruition.
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Publications

- Chapter Four: Ecological Momentary Assessment of RSOD. This Chapter study is received a revise and resubmit, details as follows: O’Donnell, Richardson, Fuller-Tyszkievicz, Liknitzky, Arulkadacham, Dvorak, & Staiger, (2018). Ecological Momentary Assessment of Drinking in Young Adults: An Investigation into Social Context, Affect and Motives. Addictive Behaviors. Refer to Appendix 4.2 for the publication

- Chapter Five: Ecological Momentary Intervention. This Chapter is under review. O’Donnell, Richardson, Fuller-Tyszkievicz, & Staiger, (2018). A Smartphone Intervention that Delivers Tailored Protective Drinking Strategies to Young Adults who Engage in Risking Drinking: A Randomised Controlled Trial. International Journal of Behavioral Medicine. Refer to Appendix 5.8 for the publication
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Abstract

Recent daily diary and Ecological Momentary Assessment (EMA) studies have shown that episodes of risky drinking by young people are largely influenced by factors within the drinking situation (i.e., social interpersonal factors) as opposed to stable invariant dispositions (i.e., drinking motives measured as trait-like). The overarching aim of this dissertation, therefore, was to understand and predict risky drinking among young people, using a framework that examined both, features of the drinking situation (i.e., momentary drinking motives, social interpersonal factors, physical location and momentary affect) and dispositional constructs (i.e., trait-like drinking motives). This evaluation was achieved through three empirical studies; first, a systematic review was conducted to synthesise the literature which examined the relationship between; drinking motives, situational factors, and alcohol use. Second, using smartphone technology, an EMA study examined to what extent dispositional drinking motives, and situational factors (i.e., momentary drinking motives, social interpersonal factors, physical location and momentary affect) predict risky drinking, among a sample of young people. The final study reports on the evaluation of an Ecological Momentary Intervention (EMI) that was disseminated to a group of young adults aged 18-35, motivated to reduce their alcohol consumption. This EMI intervened on the situational risk factors that were shown to precipitate risky drinking, based on the findings from the EMA study. In summary, this dissertation demonstrates that an effective framework to understand and predict risky drinking behaviours—among young people—is one that examines drinking motivations, at the dispositional and momentary level, coupled with risk factors present within the drinking situation.
CHAPTER ONE: RISKY DRINKING AMONG YOUNG PEOPLE

Thesis Overview

Scholars in Psychological science tend to focus on examining the consistency and stability of behaviours, with less attention directed to measuring behaviours across different situations. In fact, some researchers have gone so far as to refer to instances in which behaviour is variable, as “error”, that needs to be controlled for (e.g., Cyders, Flory, Rainer, & Smith, 2009; Reeder, Kumar, & Hesson-McInnis, 2002). However, adopting this worldview makes it very difficult to understand behaviours, that are inherently variable in nature, highly influenced by the dynamics of the situation. Risky drinking among young people is an example of this. Indeed, young people tend to exhibit a fairly stable pattern of moderate alcohol consumption (i.e., consuming four or less standard drinks), yet on occasion, they appear highly receptive to the features of the situation, and drink in a harmful and risky manner (i.e., consuming more than four drinks on a single occasion; Livingston, 2008; Murgraff, Parrott, & Bennett, 1999). The central point to be made here is, if we as researchers can understand what determines a young person’s stable pattern of drinking-related behaviours and equally, the determinants underlying atypical drinking-related behaviours (e.g., risky drinking), then drinking behaviour as a whole, can be understood. The broad aim of this dissertation is to address this by examining the drinking-related behaviours among young adults using a framework that assesses determinants that are both stable (via dispositional drinking motives), and variable (via the drinking situation and momentary motives\(^1\)) in nature.

The motivations for why young adults’ drink have been largely understood as dispositional drinking motives (e.g., Kuntsche, Knibbe, Gmel, & Engels, 2006). Indeed, in the prior decade, 1000s of studies have been published which examine the

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\(^1\) Reference throughout this dissertation of ‘momentary motives’ or ‘situation-specific drinking motives’ refers to drinking motives measured in the moment or within the situation, respectively.
relationship between dispositional drinking motives and drinking-related behaviours among young people. Dispositional drinking motives, defined as reasons for drinking that are consistent across situations and direct a person’s energies towards a drinking-related goal (Cooper, 1994), have been found to predict drinking profiles (e.g., people who are motivated to drink for social reasons are inclined to consume, on average, a moderate amount of alcohol), which has provided understanding and prediction regarding general drinking behaviours (see review by Kuntsche, Knibbe, Gmel & Engels, 2005 for more information). However, dispositional drinking motives cannot explain why people exhibit fluctuations in their drinking behaviour, that is, drinking behaviours that deviate from the persons’ motivational-drinking profile (e.g., social motivated person engages in risky drinking). As argued in this dissertation and from a relative paucity of studies employing smartphone technology (Dvorak, Pearson & Day, 2014; Thrul & Kuntsche, 2016), intra-individual variability in alcohol consumption (i.e., drinking behaviours that deviate from individuals’ average drinking behaviour) is influenced by both the immediate internal experiences of the situation (e.g., momentary affect) and external features of the setting (e.g., social interpersonal factors), neither of which are accounted for by dispositional drinking motives.

In comparison to cross-sectional measures that have been traditionally employed to examine drinking behaviour and its relevant predictors, the more modern application of smartphone technology provides two significant improvements in the assessment of drinking behaviours. First, repeated sampling of alcohol use over a number of time points. This frequent level of assessment is essential in order to capture fluctuations in drinking-related behaviours, particularly infrequent peaks in consumption such as Risky Single Occasion Drinking (RSOD, consumption of more than four standard drinks in a single setting, Wechsler,
Davenport, Dowdall, Moeykens, Castillio, 1994). Second, in-the-moment assessments offer powerful insight into the sequencing of predictors before, during and after a drinking event. In turn, this information can highlight which determinants, whether they be internal or external to the individual, are predictive of risky drinking. This thesis therefore, employs smartphone technology and aims to understand risky drinking among young adults testing a novel framework that measures the relevant predictors; drinking motives measured as dispositional and momentary in nature, in conjunction with the key features of the drinking situation (i.e., social interpersonal, physical location and momentary affect). The specific objectives of this dissertation are; (a) operationalise the key features of the drinking situation and the relationship they share with drinking motives and drinking-related behaviours; (b) examine the extent to which these key features of the drinking situation and drinking motivations (both dispositional and momentary) increase the individual’s likelihood of RSOD and drinking-related harm; (c) design an intervention which targets these situational risk factors that precipitate RSOD and drinking-related harm. A detailed description of each of the chapters within this dissertation is now presented.

**Thesis Structure**

In this short introductory Chapter, RSOD is clearly defined and the prevalence and associated harms of this behaviour are discussed within the context of young adult’s drinking. Chapter Two presents a detailed account of drinking motives, with particular attention focused on the theoretical underpinnings of Lynne Cooper’s 1994, Four Factor Motivational Model. Chapter Two provides clear evidence for the re-conceptualisation of drinking motives as being both a dispositional and momentary construct, that each account for variability in drinking-related outcomes. In Chapter Three, the results from a systematic review of the drinking-motivational literature is presented. The review
aimed to examine; (1) which features of the drinking situation have been assessed within the drinking motivational literature and; (2) what is the relationship between situational features within the drinking context, drinking motives and alcohol-related outcomes, among adults. Drawing on the findings from this review, namely, which situational features are relevant to drinking motives and alcohol use, Chapter Four presents an Ecological Momentary Assessment (EMA) study. This study examined how the four drinking motives, measured as both momentary and dispositional, interacted with the features of the drinking situation (identified in the review), to predict drinking outcomes for young adults. The drinking outcomes examined included; the number of drinking episodes reported throughout the duration of the study and the amount of alcohol consumed within each drinking episode. The final study of this dissertation, detailed in Chapter Five, reports on the development and evaluation of an Ecological Momentary Intervention (EMI), that was disseminated to a group of young adults, aged 18-35, motivated to reduce their alcohol consumption. This intervention was informed by the findings of the EMA study in Chapter Four. Specifically, the EMI was designed to deliver harm-minimisation strategies to the user that were tailored to internal and external situational factors, identified as highly predictive of alcohol consumption in the EMA study. The evaluation of the EMI was partitioned into two parts; (1) using a randomised controlled trial, efficacy of the intervention was examined, and (2) employing a qualitative study design, the usability and acceptability of the intervention was assessed. Chapter Six, presents the general discussion of the thesis, which summarises what the key implications of the current findings are, and suggestions for future research directions.
Risky Single Occasion Drinking

Definition

Risky Single Occasion Drinking (RSOD) is defined as the consumption of alcohol above recommended guidelines (e.g., 4 or more Standard drinks, or 5 or more Standard drinks depending on the guidelines of the relevant country) in a single setting, which increases the likelihood of acute harms (Gmel, Kuntsche, & Rehm, 2011; Wechsler, Davenport, Dowdall, Moeykens, Castillio, 1994). This definition differs from the traditional construct of binge-drinking, which has typically been referred to as an extended period of heavy drinking over either a single day or several days and is connected to more clinical definitions of abuse or dependence (Gmel, Rehm, & Kuntsche, 2003; World Health Organization, 1994). Given the aim of this dissertation is to examine occasional high peaks of alcohol use among young adults (18-35) who do not exhibit alcohol dependence, RSOD will be the focus of enquiry. ²

RSOD is conceptualised as an individual having X number of Standard drinks or more, on a single occasion (e.g., Wechsler, Isaac, 1992). In terms of operationalising both the number of standard drinks that meet the cut-off for RSOD, and the amount of alcohol content within each “Standard” drink, there are significant cross-country differences. For example, the definition of RSOD in the US is the consumption of five or more Standard alcoholic beverages (each drink containing 14g of ethanol; National Institute on Alcohol Abuse and Alcoholism, 2009) in a single setting for men and four Standard alcoholic beverages for women (Olthuis, Zamboanga, Ham & Van Tyne, 2011; Suffoletto et al., 201). Whereas in the UK there has been less consistency in terms of the definition of RSOD. Indeed, a seminal review by Gill in 2002 found a large

² It should be noted that not all the authors cited hereafter labelled their construct as “RSOD” rather using terms such as “binge drinking” or “heavy episodic drinking”. However, their definition corresponded to that of RSOD, excessive alcohol use in a short period of time and thus were included accordingly.
proportion of studies conducted in the UK defined RSOD as more than 7 UK Standard drinks (8g of ethanol) for females and more than 10 UK Standard drinks for males. More recent studies in the UK however, have reduced the number of drinks required to be considered ‘RSOD’ with studies defining RSOD as greater than 8 UK Standard drinks for males and greater than 6 UK Standard drinks for females (Castillo, Jivraj, & Ng Fat, 2017; Health and Social Care Information Centre, 2015). Under the Australian, 2009 National Health and Medical Research Council (NHMRC) guidelines, RSOD is defined as any episode of drinking wherein five or more Australian Standard Drinks (ASD; 10 g ethanol) are consumed, irrespective of gender. Given the focus of this dissertation is examining the drinking behaviours of young adults who reside in Australia, all references to RSOD throughout this thesis will refer to this definition of the consumption of five or more ASD in a single occasion, for both males and females. 

**Prevalence**

The prevalence rates of RSOD vary widely across countries, and it is often difficult to ascertain whether the variations are due to cultural factors, or differences in the measurement of RSOD (e.g., Plant, Plant, Miller, Gmel, & Kuntsche, 2009). In an attempt to standardise estimates of RSOD and compare prevalence rates across countries, the World Health Organisation (2014) examined the extent to which population groups, 15 years and older, consumed 60g of alcohol or more, on at least one occasion in the prior 30 days. The findings revealed 33% of adults in the UK, 24% of adults in the US and 13% of adults in Australia engaged in RSOD once in the prior 30 days. These prevalence rates are concerning; however, they are also taken from the total population group, and as RSOD has been shown to peak in early adulthood (18-35 years; NHMRC, 2009), likely underestimate the prevalence rates for young adults.

Indeed, data from the 2013 Australian National Drug Strategy Household Survey identified 47% of young Australian adults (18-24) as consuming more than four
ASD, in a single occasion, at least monthly, and 18% reported consuming more than 10 (AIHW, 2013). Similarly, Degenhardt et al., (2013) found one in five Australian males and females aged 16-24 as reporting extreme RSOD with 20+ and 11+ standard drinks consumed in a single session, respectively, in the prior month. These figures are not exclusive to Australia with comparable findings found in New Zealand (New Zealand Ministry of Health, 2010), Canada (Health Canada, 2011), and the United States (World Health Organisation, 2004).

**Harms**

RSOD has been universally associated with an increased risk of acute harms directly related to the state of intoxication; injury, blackouts, memory loss, vomiting and hangovers (Kuntsche & Gmel, 2013; Temple, Shorey, Fite, Stuart & Le, 2013). Furthermore, RSOD has been shown to increase the likelihood of unprotected sexual activity (Perkins, 2002; Townshend, Kambouropoulos, Griffin, Hunt, & Milani, 2014). A recent meta-analysis demonstrated that the intention to engage in unprotected sex increased by about 3% with a 0.10 g/ml rise in blood alcohol content (0.10 g of alcohol for every 100 mL of blood; Rehm, Shield, Joharchi, & Shuper, 2012). Finally, one in seven deaths and one in five hospitalisations among young people has been attributed to RSOD (e.g., Chikritzhs, & Pascal, 2004; Herbert, Gilbert, Cottrell, & Li, 2017), with similarly high rates reported in other studies (e.g., Australian National Council on Drugs, 2013; Kuntsche, Kuntsche, Thrul, & Gmel, 2017).

**Determinants**

In light of the numerous harms associated with RSOD, research efforts have focused on understanding what individual characteristics, neurological factors, and situational features place a young person at a higher risk of engaging in RSOD. A brief description of these key determinants is described below.

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3 As the focus of this dissertation is on drinking motives and contextual factors, a comprehensive description of each determinant related to RSOD behaviours is beyond the scope of this Chapter.
In terms of personality attributes, consistent evidence shows that RSOD is more likely among young adults who score high on extraversion and low on agreeableness (e.g., Cheng & Furnham, 2013; Zhang, Bray, Zhang, & Lanza, 2015) and high on impulsivity and sensation/novelty-seeking (Carlson & Johnson, 2012; Wellman, Contreras, Dugas, O'Loughlin, & O'Loughlin, 2014). From a neurological investigation, repeated alcohol inebriation increases sensitisation to alcohol-related cues which in turn results in attentional bias for alcohol-related stimuli (Field, Wiers, Christiansen, Fillmore, & Verster, 2010; Hicks, Fields, Davis, & Gable, 2015). In terms of situational factors present within the drinking context, studies tend to demonstrate momentary affect and social interpersonal factors as important determinants for predicting alcohol use. A number of daily diary studies demonstrate that young adults who experience strong, momentary negative affect are more inclined to then engage in heavy drinking (Grant, Stewart, & Mohr, 2009; Grzywacz, & Almeida, 2008). In terms of the influence of social interpersonal factors, peers have been shown to directly influence RSOD by either offering drinks (e.g., Schwinn & Schinke, 2014) or role modelling heavy alcohol use (e.g., Northcote, & Livingston, 2011). Moreover, alcohol-specific norms which create an overall impression of normality and acceptability of RSOD, are related to high levels of alcohol use, compared to norms that destabilise RSOD (e.g., Neighbors, Larimer, & Lewis, 2004; Van Damme et al., 2015). In sum, there has been a plethora of research conducted into which personality, neurological and situational factors predict RSOD among young adults. While each of these determinants are relevant to understanding risky drinking, the focus of this thesis is on how drinking motivations (both dispositional and momentary), coupled with features of the drinking situation, influence alcohol use.

**Drinking Motives**

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4 This dissertation defines contextual factors as internal and external factors that are evident within the drinking setting. This will be detailed in Chapter 3
Theorists argue that motivation for engaging in drinking is one of the most proximate antecedents that precedes alcohol use (e.g., Cooper, 1994; Kuntsche, Knibbe, Gmel, & Engels, 2005). Over the prior decade, 1000s of studies have been published which examine the role that dispositional drinking motives have in the prediction of different drinking outcomes, such as heavy drinking and adverse drinking consequences. As described in the next Chapter, the collective findings demonstrate dispositional drinking motivations as a powerful construct that can inform and predict general drinking behaviours (e.g., Kuntsche et al., 2005; LaBrie, Ehret, Hummer & Prenovost, 2012; Merrill & Read, 2010).

**Summary**

In conclusion, RSOD is a harmful behaviour associated with a number of adverse consequences. Yet, the prevalence of RSOD among young adults continues to rise. To intervene on this, significant research effort has been focused on understanding why young people drink, to excess. Consensus in the literature surrounds the predictive utility of dispositional drinking motives as being able to inform why young people drink and how much they are likely to drink, at any one time. However, as described in the next Chapter, recent evidence (e.g., Dvorak, Pearson, & Day, 2014; Kuntsche, Otten, & Labhart, 2015) suggests that the conceptualisation of drinking motives, as a dispositional construct that is invariant across situations (e.g., a person is motivated to drink for social motives across every situation), may impede upon its predictive utility. Chapter Two will explore this by first, reviewing the most commonly applied framework of dispositional drinking motives, Cooper’s (1994) Four-Factor Motivational Model and second, presenting the evidence on how a re-conceptualisation of drinking motives as dispositional and momentary (rather than only dispositional) could be an advantageous model to predict and prevent risky drinking among young people.
References


Gill, J. S. (2002). Reported levels of alcohol consumption and binge drinking within the UK undergraduate student population over the last 25 years. *Alcohol and Alcoholism*, 37(2), 109–120


CHAPTER TWO: DRINKING MOTIVES

Motivation, defined as the psychological process that instigates the arousal, direction, and persistence of behaviour (Atkinson, 1964; Campbell, Dunnette, Lawler, & Weick, 1970), has been traditionally viewed as a causal force which is a proximate predictor for a variety of behaviours, including alcohol use (Cox, & Klinger, 1988). Since 1975 (e.g., Hanson, 1975), the motivations that young adults’ endorse for drinking has received significant attention. Indeed, there has been over 1,500 publications in the last 40 years that have examined what motivates young people to drink. The findings demonstrate that adolescents’ drink for either; internal, affective reasons (e.g., sadness or boredom), or external, social reasons (e.g., social lubrication; Kuntsche, Knibbe, Gmel, & Engels, 2005; Kuntsche & Müller, 2012). And, those who drink for internal, affective reasons have been shown to drink in a heavier and frequent manner, compared to individuals who drink for external, social reasons (Armeli, Conner, Cullum, & Tennen, 2010; Park & Levenson, 2002). Understanding what drives young people to drink is an important construct to being able to predict prospective drinking behaviours and additionally, who may require intervention. However, before the relationship between drinking motives and alcohol use can be described, a clear operationalisation of the term ‘drinking motives’ is needed.

Drinking Motives Definition

Whilst no single definition of drinking motives\(^5\) has been unanimously accepted in the literature, studies typically adopt Kuntsche, Knibbe, Gmel and Engels’ (2005) description of drinking motives as “conscious or unconscious reasons for drinking… that directs a person’s energies towards a goal” (p. 845). One instance of the heterogeneity found in the literature is illustrated by the interchangeable reference to

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\(^5\) Unless otherwise specified reference to ‘drinking motives’ refers to dispositional drinking motives, rather than motives measured in a momentary manner.
reason when referring to drinking motives, suggesting that these concepts have the same function and pathway in drinking-related behaviour (Baer, 2002; Stewart & Chambers, 2000; Stewart & Devine, 2000). Yet, reasons for drinking imply a more rational response as the individual considers the sum of their decision to drink, both the rewards (e.g., gain greater pleasure) and the consequences (e.g., being hungover the following day; Comasco, Berglund, Oreland, & Nilsson, 2010; Pang, Wells-Parker & McMillen 1989). Whereas motives appear to be defined as generalised reasons for drinking (i.e., to enhance mood), rather than consideration of the reasons against drinking (e.g., being hungover, for a review refer to Kuntsche, Knibbe, Gmel & Engels 2005; Berkowitz & Perkins, 1986; Smith, Abbey & Scott, 1993). Therefore, subsequent reference to drinking reasons will refer to rational thoughts underpinning the decision to drink that include both the benefits and consequences of drinking. Motives on the other hand, will refer to specific categories, factors, or dimensions, which are only desirable in nature and serve a purpose in the decisional framework of drinking-related behaviour.

**Outcome Expectancies**

As evident in Figure 1 and through reviewing the drinking-motivational literature, it becomes clear that a wealth of research focuses on the dual role that drinking motives and alcohol-related outcome expectancies have within the drinking process. Outcome expectancies are defined as the beliefs regarding the likelihood of experiencing certain effects (i.e., positive, negative) from drinking alcohol (Goldman, 1994; Wardell & Read, 2013). A rich body of literature has found that when individuals endorse positive expectancies regarding alcohol use (e.g., alcohol helps to socialise and meet others) it increases alcohol consumption (Goldman, Del Boca & Darkes, 1999; Jones, Corbin & Fromme, 2001). In contrast, negative alcohol expectancies (e.g., alcohol will make me tired) share a less consistent relationship with drinking-related outcomes; some studies reveal a positive relationship to alcohol consumption (i.e.,
Armeli, Todd, & Mohr, 2005; Patrick & Maggs, 2008) while others find a negative relationship to alcohol consumption (i.e., Jones, Corbin & Fromme; Kuntsche et al., 2005).

Although some theorists argue that motives and expectancies are equally important in the decisional process of alcohol consumption (e.g., Cox and Klinger; 1988; 1989), it is argued herein and from by a broader array of research that drinking motives are more proximate determinants underlying alcohol-related behaviours, compared to expectancies, and as such, share a stronger relationship with drinking-related outcomes (e.g., Kuntsche, Knibbe, Gmel, & Engels, 2005; Kuntsche, Knibbe, Gmel, & Engels, 2006b). This is illustrated in Hasking, Lyvers, Carlopio and Raber’s (2011) study which examined the extent to which drinking motives and alcohol expectancies are associated with scores on the Alcohol Use Identification Test (AUDIT) for 454 young adults ($M_{age} = 23.44$ years, $SD_{age} = 7.03$ years). The results found higher correlations between drinking motives and scores on the AUDIT (ranging from $r = .54$ to $r = .59$), as compared to alcohol expectancies and scores on the AUDIT (ranging from $r = .01$ to $r = .46$). Similarly, Kuntsche, Knibbe, Engel and Gmel’s (2007b) tested whether the link between alcohol expectancies and alcohol use (drinking frequency and RSOD) was mediated by drinking motives among 5,616 adolescents ($M_{age} = 15.1$ years, $SD_{age} = 1.0$ years). The results found when drinking motives were included in the analysis, a perfect mediation to alcohol use was observed; that is, the previous significant relationship between outcome expectancies and alcohol use was reduced to non-significant when motives were included in the model. These findings demonstrate drinking motives as the more proximate determinant of alcohol use, above and beyond outcome expectancies. This dissertation therefore will focus primarily on the

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6 Goldman, Del Boca, and Darkes (1999) disagree that drinking motives are the most proximate determinant of alcohol use and rather state the alcohol expectancies are the final determinant predicting drinking behaviours.
functioning and utility of drinking motives and discussion of outcome expectancies will only be made when relevant to drinking motivational processes.

Figure 1: Adapted from Cox and Klinger’s 1988 Motivational Model

Four Factor Motivational Model

Introduction

Since 1954, over 2,000 articles have been published that examine the relationship between drinking motives and alcohol outcomes, with the large proportion of these studies focused on young adults (approximately 1,500). Since its inception in 1994, consensus has formed within this literature around the application of the Four-Factor Motivational Model developed by Lynne Cooper as a well-validated framework that operationalises the various motives young adults subscribe to for drinking (e.g., Kuntsche, Knibbe, Gmel, & Engels, 2006b; Kuntsche, Stewart, & Cooper, 2008;
MacLean, & Lecci, 2000). The subsequent section briefly details the following features of the Four-Factor Model: (i) Miles Cox and Eric Klinger’s theoretical underpinnings of the Four Factor Model; (ii) the affiliated conceptual frameworks (i.e., Three and Five Factor Models); (iii) the amount of variance the Four Factor Model can explain in drinking outcomes and; (iv) the relationship shared between each of the four drinking motives and drinking-related outcomes (i.e., alcohol use and adverse consequences). The reader is then guided into the final component of this chapter, the proposed re-conceptualisation of drinking motives as a construct that has both dispositional-stable properties and situational-momentary properties.

**Theoretical Underpinning: Cox and Klinger**

The final decision to drink (or not) is explained by Cox and Klinger (1988; 2002) to be typically volitional (i.e. voluntary) in nature, however they do acknowledge that for some, the drinking motives underlying alcohol-related behaviour can function in an automatic manner. Indeed, they suggest that motivational processes surrounding alcohol use can occur without awareness as an individual can become unconsciously sensitised towards particular drinking-related cues (i.e., others’ heavy drinking), which in turn instinctively reinforces drinking (Cox et al. 2002; Ramirez, Monti, & Colwill, 2015).

Cox and Klinger (1988; 2002) developed a model for categorising one’s motive to drink based on the interaction between the various reinforcement factors described above (i.e., positive and negative). Specifically, they posit that motives can be meaningfully operationalised according to two dimensions, the valence (positive or negative reinforcement) and the source (internal or external) of the outcome the individual wishes to achieve from drinking. That is, an individual may drink to obtain a positive outcome, such as enhancing positive mood (positive reinforcement) or to avoid an adverse consequence (negative reinforcement; Cox & Klinger, 1988). Moreover,
drinking may be stimulated by internal rewards (i.e., management of one’s emotional state) or external circumstances (i.e., social acceptance; Cox & Klinger, 1988). While this model did not directly incorporate drinking motives, preferring the term ‘decision to drink’ and ‘decision not to drink’ (refer to Figure 1 for more information), Cox and Klinger were integral to the development of later models of drinking motives. Indeed, using this framework as a foundation, Cooper (1994) developed the Four-Factor Motivational Model by crossing these two dimensions (source and valence) which yielded four theoretically distinct drinking motives: (1) drinking to enhance positive affect (‘enhancement’; positive, internal) (2) drinking to avoid or reduce negative affect (‘coping’; negative, internal) (3) drinking to fit in with others (‘conformity’, negative, external) and (4) drinking for social facilitation (‘social’; positive, external). The following section outlines how the Four Factor Motivational Model, and conceptually related models evolved from Cox and Klinger’s (1988) motivational framework.

**Motivational Models of Alcohol Use**

The literature is characterised by a diverse range of frameworks that have attempted to operationalise and assess one’s proposed motive for drinking based on the theoretical underpinnings of Cox and Klinger’s model (for a comprehensive review see Beaton, 2014). The subsequent section will explore the utility and validity of the Three-Factor Motivational Model (e.g., Cooper, Russell, Skinner & Windle, 1992), the Four-Factor Motivational Model (Cooper, 1994) and the Five-Factor Motivational Model (Blackwell and Conrod (2003).

Initially, Cooper, Russell, Skinner and Windle (1992) developed a *Three-Factor Motivational Model*, which conceptualised drinking motives in terms of three dimensions: coping (i.e., drinking to cope with negative affect), enhancement (i.e., drinking to enhance positive affect) and social (i.e., drinking to improve social interactions). Clear support for this Three-Factor Model was demonstrated by Cooper
and colleagues as confirmatory factor analyses indicated that the motivation for why the adults in their sample drank, was best explained by the Three-Factor Model as compared to a two-factor (i.e., enhancement constrained to load on social motives) or a one-factor (i.e., a single motivational factor) model. This was specifically evident by the values of Normed Fit Index (NFI) and Comparative Fit Index (CFI) exceeding .90 and a relatively small Root Mean Square Residual (RMR) of .04 for the model. Several studies attest the good psychometric (i.e., validity and reliability) properties of this Three-Factor framework (i.e., Colder, 2001; Colder & O'Connor, 2002; Gire, 2002).

According to the writings by Cooper (1994) however, it appeared that whilst the Three-Factor Model demonstrated utility in understanding drinking related behaviour, she posited that it lacked an important reinforcement for consumption, namely, drinking to conform with others. Indeed, she hypothesised that peer pressure would be an important contributor to drinking-behaviour, particularly among adolescents. Given this, the theoretical underpinnings of the Three-Factor Model were extended into Cooper’s ‘Four Factor Motivational Model’ (1994) which operationalised individuals’ motives for drinking according to one of four factors; (a) Coping (internally generated, negative reinforcement) that is drinking to alleviate negative emotions; (b) Enhancement (internally generated, positive reinforcement) which refers to drinking to enhance positive affect and wellbeing; (c) Social (externally generated, positively reinforced) drinking to obtain social rewards or improve social gatherings; and (d) Conformity (externally generated, negatively reinforced) which refers to drinking to fit in or avoid social rejection. Cooper (1994) used confirmatory factor analyses to examine the factor structure of the model and results found the model was a good fit to the data (i.e., $X^2$ (164) = 1006, $p<.05$, NFI=.93, CFI=.94, RMSEA=.05) and more superior when compared to alternative models (i.e., a one-factor, two-factor or three-factor model). Although it is worth noting that social and enhancement motives shared a high
correlation ($r=.68$), suggesting that there is some conceptual overlap between what these factors are measuring. However, as this correlation does not approach multicollinearity (Grewal, Cote, & Baumgartner, 2004) it does suggest that these constructs are important as individual factors. In terms of cross-country validation, the structure of this model has been confirmed across; North America (Cooper, 1994; Cooper et al., 2008; Kuntsche, Stewart & Cooper, 2008) South America (Hauck-Filho et al., 2012), Australia (Norberg, Norton, Olivier, & Zvolensky, 2010) and Europe (Gmel, Labhart, Fallu, & Kuntsche, 2012). Finally, the internal consistencies of each of the four subscales have been demonstrated as very good, falling within a range of .75 to .95 (Kuntsche, Knibbe, Gmel, & Engels, 2006b).

The formation of this model has influenced the literature in two important ways; first, the model delivers an agreed upon consensus on how drinking motives should be conceptualised, facilitating theoretical consistency. Second, it has fostered empirical consistency as a well-validated measure of drinking motives (Drinking Motive Questionnaire Revised [DMQ-R]), was developed and widely applied (Comeau, Stewart & Loba, 2001; Hussong, 2003). A review of the motivational literature conducted by Paul Beaton (2014) supports this as the large majority of studies completed in the last several years conceptualised drinking motives according to Cooper’s Four Factor Motivational Model and applied the DMQ-R to measure motives. Applying this framework consistently has enabled researchers to synthesise, replicate and validate how drinking motives relate to specific drinking-related outcomes (Kuntsche, Knibbe, Gmel & Engels, 2005; Kuntsche, Knibbe, Gmel, & Engels 2006a). These contributions are examined in a subsequent section.

Finally, it is worth noting that more recently, a Five-Dimensional Model has been proposed by Blackwell and Conrod (2003). This modified version consists of the same motives proposed by Cooper with one difference: coping motivated drinking was
differentiated into drinking to cope with depression (coping-depression) and drinking to cope with anxiety (coping-anxiety; Grant, Stewart, O’Connor, Blackwell & Conrod, 2007). A recent review by Kelly (2011) identified the model as an adequate fit for a sample of young adults (i.e., $M_{\text{age}}$ 28 years; $\chi^2 (338, N=590) = 1300, p<.05, \text{CFI}=.88, \text{TLI}=.87, \text{RMSEA}=.07, \text{SRMR} = .07$). However problematically, a strong correlation was identified between coping-depression and coping-anxiety ($r = .92$), suggesting poor discriminant validity. This was further evident by the lack of distinct relationships shared between the two coping-motives and alcohol-related outcomes (i.e., both were associated with alcohol-related problems rather than alcohol use). As such, it does not appear worthwhile to separate drinking to cope with anxiety from drinking to cope with depression as they appear to be measuring the same construct.

In conclusion, this discussion shows that each of the motivational models sufficiently conceptualise an individual’s motivation to drink based on the underpinnings of Cox and Klinger’s (1988) framework. However, the most convincing empirical and theoretical support surrounds the application of the Four Factor Motivational Model.

**Four Factor Motivational Model and Alcohol-Related Outcomes**

Having defined the Four-Factor Motivational Model, an important next step is to establish the current evidence regarding the relationship between each of the four motives and alcohol-related indicators. An overview of the following results is detailed below; (i) the collective utility of the Four-Factor Motivational Model in predicting both alcohol consumption (i.e., frequency and quantity) and consequences (i.e., social and academic problems) and; (ii) a detailed analysis on how each of the four motives (social, enhancement, coping and conformity) distinctly predict both alcohol use indicators and adverse alcohol-related consequences. This information will help to ascertain the predictive utility of the motivational model which will lead the reader into
the proposed re-conceptualisation of drinking motives.

**Predictive Utility of the Four-Factor Motivational Model**

In terms of the predictive utility of the Four Factor Motivational Model, findings tend to consistently show the model as explaining a moderate amount of variance in alcohol-related outcomes; frequency and quantity of alcohol use. However, there is far greater inconsistency in the association between the Four Factor Model and adverse drinking-related consequences. These findings are described in the subsequent section.

The Four-Factor Model has been identified as consistently predicting a moderate amount of variance in alcohol consumption indicators; frequency and quantity of alcohol consumption. For instance, Kunstche, Stewart and Cooper’s (2008) study investigated the utility of the model in explaining the drinking behaviour of adolescents ($M_{age}=15$ years, $SD_{age}=0.93$) in Switzerland, Canada and the U.S. The results found that the inclusion of the four drinking motives, as dispositional characteristics, in a Structural Equation Model (SEM) explained approximately 22% of the variance in the frequency that adolescents drank in the prior 30 days, across each of the three countries. Comparable findings, among a group of young adults ($M_{age}=18.6$ years; $SD_{age}=0.56$), has also been identified (e.g., Read, Wood, Kahler, Maddock & Palfai, 2003). Similarly, a moderate proportion of the variance in the quantity that individuals drink, is explained using drinking motives. Indeed, prior research identifies the Four-Factor Motivational Model as explaining roughly 20% of the variance in the quantity of alcohol consumed (Cooper, 1994; Kunstche, Stewart, & Cooper).

In contrast, there has been less consistent associations found between the predictive utility of the Four Factor Model for adverse drinking-related consequences. Indeed, some research finds drinking motives, measured collectively, as explaining a significant amount of variance in drinking-related consequences (e.g., 20%; Cooper, 1994) whilst other studies find only a small amount of variance in drinking
consequences as explained by the drinking motives (e.g., 6%; Kuntsche, Knibbe, Gmel, & Engels, 2006a). A reason for this heterogeneity found across the literature could be a result of the conceptualisation of drinking-related consequences. Indeed, the studies that defined drinking-related consequences as a function of less severe problems found the drinking motives to significantly predict these outcomes (e.g., Stewart, Morris, Mellings, & Komar, 2006). For example, in Cooper’s (1994) study, drinking problems were measured specific to the following life domains; parents, friends, dating partners, at school, or at work and 20% of variance in these drinking-related issues could be explained as a combined function of the four dispositional drinking motives. A similar figure was also identified in Stewart, Morris, Mellings and Komars’ study who found 36% of variance in less severe drinking-related problems (e.g., unable to work or do homework) was explained using the four dispositional drinking motives. Whereas, the studies that conceptualised drinking-related consequences as a function of more severe problems were not significantly explained by the motivational framework (e.g., Carey & Correia, 1997). For example, Kuntsche, Knibbe, Gmel and Engel’s (2006a) study assessed drinking problems through three serious categories; poor academic performance, violent behaviour, and unwanted sexual intercourse and found only roughly 6% of variance in these behaviours were explained by dispositional drinking motives. Additional evidence for a weak relationship between severe drinking consequences and dispositional drinking motives also comes from Martens, Cox, and Beck (2003) who found 10% of the variance in serious drinking-related consequences (e.g., drunk-driving) could be explained by the collective function of the drinking motives.

In sum, these findings confirm the motivational model as an important framework in explaining a consistent amount variance in both the frequency and quantity of alcohol consumed, across countries. In contrast, the Four-Factor
Motivational Model has selective associations with adverse drinking-related consequences, explaining considerably more variance in drinking-related consequences moderate in severity (e.g., Cooper, 1994) as compared to high in severity (e.g., Kuntsche, Knibbe, Gmel, & Engel, 2006a). As will be described in detail below, younger adults are typically motivated to drink for reasons that are unrelated to severe drinking consequences. That is, young adults tend to drink to satisfy interpersonal needs of social lubrication (social motives e.g., Kuntsche, Knibbe, Gmel, & Engels, 2005), and studies generally find, drinking for this motivation is unrelated to the experience of serious drinking-related consequences (e.g., Kuntsche, & Kuntsche, 2009). In contrast, young adults tend to seldom endorse coping motives, which is consistently associated with severe drinking related consequences (e.g., Norberg, Olivier, Alperstein, Zvolensky & Norton, 2011). These two lines of evidence help us to understand why the motivational model is better applied to understanding consequences that are moderate rather than severe in nature.

**Individual Drinking Motives and Alcohol Outcomes**

The literature shows a distinct relationship between drinking motives and alcohol-related outcomes among young adults; young individuals who endorse positively-oriented motives (social and enhancement) are inclined to consume moderate to heavy levels of alcohol, whereas young adults who typically drink for negatively oriented motives (coping and conformity) are likely experience adverse drinking-related consequences. A detailed analysis of these findings is presented below.

i. *Social motives*, (e.g. ‘drinking to help celebrate with friends’) is the most commonly endorsed motivation for drinking among young adults (Kairouz, 2005).

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7 There is a lower prevalence of severe drinking consequences exhibited in the general population which may contribute to this finding
Gliksman, Demers & Adlaf, 2002). The majority of papers have found supporting evidence for the association between drinking for dispositional social motives and consuming a moderate amount of alcohol (e.g., Cooper, 1994; Grant et al., 2007; Kairouz, Gliksman, Demers, & Adlaf; Kassel, Jackson, & Unrod, 2000; Kuntsche et al., 2005; Kuntsche et al. 2006b; Muller & Kuntsche, 2011; Read, Wood, Kahler, Maddock, & Palfai, 2003). An illustrative example is demonstrated in Lee, Geisner, Lewis, Neighbors, and Larimer’s (2007) study which examined the drinking behaviours of 1,400 first-year college students ($M_{age}$=18.41 years, $SD_{age}$=0.55 years) and found dispositional social motives were strongly positively correlated with a moderate number of drinks per week ($M$=5.09, $SD$=7.63; $r$=.53). Though, not all studies have found a positive relationship between the endorsement of dispositional social motives and drinking a moderate amount of alcohol, with some studies finding a null association between these constructs (e.g., Merrill & Read, 2010; Read, Wood, Kahler, Maddock, & Palfai, 2003). For example, Kuntsche and colleagues (2008) examined the relationship between dispositional social motives and alcohol outcomes for young adults ($M_{age}$=15 years, $SD_{age}$=0.93) across countries including; Canada, United States and Switzerland. The results found that endorsement of dispositional social motives was not significantly related to alcohol frequency, quantity or RSOD across any of these countries.

To summarise this information, research generally finds that young adults’ who drink for dispositional social motives tend to be characterised as moderate drinkers, put simply, they consume relatively small quantities of alcohol on infrequent occasions (e.g., Grant et al., 2007). As the purpose of drinking for social reinforcement is to facilitate interpersonal interactions, it is
understandable why these individuals would exhibit drinking behaviours that are in fact controlled and moderate, rather than to the point of intoxication, as this would likely impede on the outcome they wish to attain (e.g., social connectedness). Notwithstanding these findings, it is important to emphasise that there are some studies that suggest social dispositional motives may not serve as a central pathway to drinking among young adults (e.g., Kuntsche, et al., 2008). Further investigation of this relationship, and in particular, under what circumstances social dispositional motives are positively related to moderate drinking patterns, is needed.

In terms of the relationship between social motivation and adverse alcohol-related consequences, the findings are somewhat inconsistent. For example, Lyvers and colleagues (2010) found a strong relationship between young adults ($N=221; M_{age}=22$ years, $SD_{age}=3.40$) who endorsed social dispositional motivations for alcohol use, and their scores on the Alcohol Use Disorders Identification Test (AUDIT), specifically their total score ($r=.55$), alcohol problems ($r=.43$), and alcohol dependence ($r=.37$). Similar findings were reported by O’Connor and Colder (2005) and Rafnsson, Jonsson, and Windle (2006) who found a positive relationship between social dispositional motives and wider alcohol-related problems (e.g., physical fights or problem with friends). However, when studies controlled for the effect of alcohol consumption, social motivation tended to show no association on a range of negative consequences (e.g., from risky sexual intercourse to academic problems; Labouvie & Bates, 2002; Merrill & Read, 2010). This may suggest that social dispositional drinking motives may share an indirect association with drinking-related consequences, via the mediating role of increased alcohol consumption. Further conclusive analysis of this relationship is required.
ii. **Enhancement motivation** (e.g. ‘to feel good’) is related to frequent, heavy episodic drinking. For example, in a study of 316 young adults ($M_{age}=18.48$ years; $SD_{age}=1.81$) Lewis and colleagues (2008) found dispositional enhancement motives, more so than the other motives, to be the strongest predictor of heavy episodic drinking ($r = .37$). With very few exceptions (Merrill & Read, 2010; Siviroj et al., 2012) the large proportion of the literature support this finding (Cooper, 1994; Kairouz, Gliksman, Demers & Adlaf, 2002; Kuntsche, et al., 2008; Kuntsche & Kuntsche, 2009; Kunstche & Stewart, 2009; Van Tyne et al., 2012).

Regarding the association to problematic alcohol-related consequences, recent studies have found a positive correlation between enhancement dispositional motives and young adults’ scores on the alcohol-related problem subscale of the AUDIT ($r = .36$, Willem et al., 2012) and the Rutgers Alcohol Problem Index (RAPI; $r = .51$, Németh, et al., 2011). Yet, in a similar respect to social dispositional drinking motives, the relationship between enhancement dispositional motivation and alcohol-related consequences, appears to be more of a function of increased alcohol use, rather than sharing direct association to drinking-related harm (e.g., Merrill, Wardell, & Read, 2014).

In conclusion, the literature shows drinking to enhance internal experiences (i.e., thoughts, feelings or sensations) as predictive of heavy, episodic drinking. Furthermore, these individuals do experience drinking-related consequences, though this appears to be a function of the amount of alcohol they consume, rather than the motive in which they drink for.

iii. **Coping motives** (e.g. ‘to forget worries or concerns’) are the least frequently endorsed drinking motivation, among young adults (Cooper, 1994; Kuntsche, Knibbe, Gmel & Engels, 2005). In terms of the relationship between endorsing
coping motives and drinking-related outcomes, inconsistencies across the literature are recognised. Indeed, a small subset of studies have examined a moderate, positive relationship between coping dispositional motivations and drinking-related outcomes (i.e., frequency and quantity; Cooper, Agocha, & Sheldon, 2000; Labouvie & Bates, 2002). For example, Goldstein and Flett (2009) examined the drinking behaviour of 138 first year students and identified a moderate, positive correlation between endorsing dispositional coping motives and drinking quantity \((r = .28)\) and binge-drinking \((r = .42)\). Whilst this is a strong effect, most of the literature has found no significant relationship between dispositional coping motives and drinking quantity (Kunstche et al., 2006b; Kuntsche et al., 2011; Martens, Pedersen, Smith, Stewart & O'Brien, 2011; Merrill & Read, 2010). What does appear to be clear is that people who drink for dispositional coping motives tend to also experience drinking-related consequences, such as poor self-care \((r = .34)\) and blackouts \((r = .24)\) (Merrill & Read). Comparable findings are evident in Norberg, Olivier, Alperstein, Zvolensky and Norton’s (2011) study, which reported a significant, positive association between dispositional coping motives and social consequences (i.e., verbal argument or physical conflict) even when controlling for factors such as gender and quantity of alcohol consumed. Numerous additional studies provide support for the positive relationship between dispositional coping motives and elevated AUDIT (Arbeau et al., 2011; Van Tyne et al., 2012) and RAPI (Lewis et al., 2008; Neighbors et al., 2004) scores.

In summary, the literature shows that individuals’ who are motivated to drink for coping motives show inconsistencies in the frequency and the quantity in which they drink. Though, coping-motivated drinkers are
consistently shown to experience adverse drinking-related consequences such as, social interpersonal problems and issues with self-care. This suggests that those who drink to cope, may be attempting to compensate for deficits in their coping strategies, and thus, the issues that cause stress or negative affect are not being effectively managed (Cooper; Kuntsche, Knibbe, Gmel & Engels).

iv. Conformity motives (e.g. ‘drinking to fit in’) appear to be inconsistently related to indicators of alcohol use. Roughly half of the studies in the literature found no significant association between dispositional conformity motives and alcohol consumption (e.g., Lewis et al., 2007; Lyvers et al., 2010; Merrill & Read 2010; O’Connor & Colder, 2005), 25% of studies showed a negative relationship with alcohol use (e.g., Ham, Zamboanga, Bacon & Garcia, 2009; Kuntsche, Stewart & Cooper, 2008) and 25% of studies identified a weak positive relationship with alcohol use (e.g., Neighbors et al., 2004; Norberg et al., 2010).

Though, a number of studies have found a significant relationship between individuals’ who drink for dispositional conformity motives and their subsequent experience of drinking consequences including; elevated scores on the RAPI (Lewis et al., 2008; Neighbors et al., 2004) and the AUDIT (Arbeau et al., 2011) and diminished self-perception and impaired control (Merrill & Read, 2010). Furthermore, studies have shown that individuals who exhibit social anxiety tendencies as more inclined to drink for dispositional conformity motives (Lewis et al., 2008; Norberg, Norton, Olivier & Zvolensky, 2010). It is possible that young people who drink to conform with others, find it particularly challenging to be assertive and resist peer pressure in drinking situations, increasing their likelihood of experiencing adverse alcohol-related consequences.
Summary

In summary, prior research has established that the four drinking motives are associated with different drinking-related outcomes. Indeed, young adults characterised as moderate or heavy drinkers tend to be motivated to drink for social or enhancement motives, respectively. Whereas, individuals who report experiencing adverse drinking-related consequences were shown to drink for coping or conformity motives.

These findings demonstrate that the value of dispositional drinking motives is that they predict typical patterns of drinking behaviour (e.g., those who drink to cope are generally likely to experience drinking consequences). This information can be used to make general predictions about who might be at risk of developing drinking-related problems (e.g., those who drink to cope). It is clear that the amount of alcohol young adults consume at any one time, however, can fluctuate substantially. Of relevance to this dissertation is understanding why on some occasions, young adults engage in Risky Single Occasion Drinking (RSOD, consumption of five or more Australian Standard Drinks [ASD]). In the subsequent section, it is argued that re-conceptualising drinking motives as a dispositional-momentary construct, is imperative to being able to predict and explain occasions of risky drinking.

A Re-Conceptualisation of Drinking Motives

Drinking-motivational theorists have not neglected to consider that one’s drinking motivation can change across situations. Indeed, Cooper shed light on this in her 1995 seminal paper by stating “a trait-like conceptualization may be appropriate for some subgroups, (though) it would appear misleading and inappropriate for the majority of drinkers”, she went onto argue that it is important to view drinking motives as “situationally activated processes”. But despite this statement, attention given to the
conceptualisation and measurement of drinking motives as momentary constructs that are situation specific, has been largely neglected. Indeed, Beaton (2014) performed a systematic review of the drinking motivational literature (in the prior decade) and found virtually all the studies (98%) had operationalised and measured drinking motives as *trait-like* concepts. That is, past research has not considered if and how an individual’s self-reported motivation for drinking differs according to the characteristics associated with the drinking situation (e.g., affect, peer influence etc.). This is particularly evident in the commonly applied measure of drinking motives, the Drinking Motive Questionnaire-Revised (DMQ-R, Cooper, 1994), which instructs the individual to “consider all the times you drink, how often would you drink for these reasons” rather than specifying why the person drinks with certain situations.

In proposing this re-conceptualisation, it is important to note that this thesis is not rejecting the existence nor utility of dispositional drinking motives. Rather, the central premise is that a more advantageous operationalisation of the construct—with the potential to show a stronger, more informative relationship with alcohol outcomes—is drinking motives conceptualised as exhibiting *both* dispositional and momentary, situation specific properties. For example, it may be that an individual is typically motivated to drink for social reasons. However, after a particularly difficult day at work with a high level of negative affect, the individual feels inclined to drink, predominately as a coping mechanism, which would not be detected when measuring their dispositional motivation for drinking.

Up until this point, this thesis has focused exclusively on the evidence pertaining to dispositional drinking motives. What is unclear however, is the evidence for the proposition that drinking motivations also exhibit change across situations. Using the following four lines of evidence; (*i*) alcohol use influenced by the situation; (*ii*) analytical studies conducted by Beaton in 2015; (*iii*) daily diary and (*iv*) Ecological
Momentary Assessment (EMA) studies, empirical support for the proposed re-conceptualisation is provided.

Evidence for the Re-Conceptualisation

Alcohol Use

An extensive body of work supports the view that alcohol consumption is itself, a situation specific behaviour, which varies depending on a number of situational factors including; the location (Anderson, Duncan, Buras, Packard, & Kennedy, 2013; Kuntsche & Kuendig, 2012; Mohr et al., 2005) and the age and sex of the social companions present within the drinking context (Buckner, Schmidt, & Eggleston, 2006; Cullum, O’Grady, Armeli & Tennen, 2012; Mohr et al., 2013). An illustrative example comes from Demers and colleagues’ (2002) study which found situational factors such as the physical location, time of day, and the types of social companions present, as explaining a significant proportion of variance (i.e., 51%) in the amount of alcohol consumed. These situational factors were found to be as equally important as the individual’s characteristics, such as the gender and age, in explaining the quantity of alcohol consumed (i.e., explaining 49% of the variance). As a wealth of evidence highlights drinking behaviour as largely functioning in a situation-specific manner, it is then reasonable to anticipate that the underlying cognitions of this behaviour, drinking motives, should also operate in a similar situation-specific fashion. Further convincing support for this idea is derived from recent analytic findings (i.e., CFA and MLM) by Beaton (2014).

Analytic Strategies

The aim of Beaton’s dissertation (2014) was to examine if young adults’ drinking motivation varied across situations. To address this, two studies were undertaken that employed unique analytical procedures, Confirmatory Factor Analyses
(CFA) and Multi-Level Modelling (MLM). The findings from these studies unequivocally demonstrated the importance of examining drinking motives as both a dispositional and situation specific construct. The first study employed CFA to examine the extent to which drinking motives, from an empirical standpoint, were better conceptualised as situation specific or dispositional in nature. This was tested by asking a large number of young adults (N=442; $M_{\text{age}}=24.1$ years, $SD_{\text{age}}=3.79$ years) to complete a modified version of the Drinking Motives Questionnaire Revised (DMQ-R; Cooper, 1994). Rather than reporting their motivations for drinking in general, participants were asked about their drinking motivation within three different situations; being at home, at a party, and during a multi-generational event (e.g., celebratory occasions in which multiple generations of people are present). Thereafter a series of CFA were conducted to compare two models: one model which characterised each drinking motive as a single factor, dispositional in nature – invariant across three situations (i.e., home alone, at a party and at a family event) and a second model which represented each motive varying across three situations – modeled as situation-specific. The fit statistics for the single factor, dispositional model, was well below the cut-offs for acceptable fit. In contrast, fit statistics for the three-factor, situation specific model, was consistently above the cut-off, indicating excellent model fit. Lastly, the Intra-Class Correlations (ICC) reported in an MLM demonstrated each of the four drinking motives as exhibiting only small to moderate values of cross-situational stability (ICC ranged from .47 to .11). Taken together, these analytic findings lend empirical support for the notion that drinking motives do indeed vary meaningfully, from one drinking occasion to the next. The following section presents research from daily diary studies that highlight the predictive utility of drinking motives, measured at the situational level.

**Daily Diary Studies**

Daily diary methodology is defined as repeatedly measuring a target behaviour
in a retrospective manner, using a journal type assessment that is provided in either a
hard copy (Affleck, Zautra, Tennen & Armeli, 1999) or via a technological source such
as a secure website (Merz & Roesch, 2011). As daily diary studies permit researchers to
investigate why behaviours, such as alcohol use, vary across situations, their popularity,
particularly within the drinking motivational research, has increased significantly in the
prior decade (e.g., Gunthert & Wenze, 2012). Indeed, daily diary studies have shown
young adults as exhibiting variability in their drinking motivations across situations, and
this variability has been associated with alcohol use either directly (Linden-Carmichael
& Lau-Barraco, 2018), or indirectly via interactions with social interpersonal factors
(O'Hara et al., 2014; O'Hara, Armeli & Tennen, 2015). These studies are described in
detail below.

First, Linden-Carmichael and Lau-Barraco (2018) examined the role drinking
motives, conceptualised as both dispositional and situation specific, have in predicting
occasions marked by the consumption of Alcohol mixed with Energy Drinks (AmEDs).
The sample comprised 122 participants aged 18-25 who completed; (i) a baseline
survey that assessed drinking motives at the dispositional level and (ii) a daily diary
assessment for 14 days which examined drinking motives, within the drinking situation
(“thinking about your drinking last night how much did you drink for each of these
reasons”), and the amount of AmED consumed. This study found situational drinking
motives directly related to AmED use (conformity and enhancement motives were
positively and negatively related to AmED consumption, respectively), while no
dispositional motives shared a significant relationship with AmED use. This finding
suggests that drinking motives, at the situational-level, not only exist but they appear to
explain AmED use far more effectively than motives measured at the dispositional
level.

Two daily diary studies to date (i.e., O'Hara et al., 2014; O’Hara, Armeli &
Tennen, 2015) have examined how dispositional and situational drinking motives, interact with social, interpersonal factors within the drinking situation to predict drinking behaviours. These studies employed a similar protocol to that described above; a baseline survey of drinking motives and a daily-diary assessment for 30 days, examining who the individual was with (i.e., with others [social] or alone [non-social]), their motivation for drinking and alcohol use indicators. The key difference between the studies was the composition of the sample; O’Hara and colleagues (2014) sampled 462 African-American students, while O’Hara, Armeli and Tennen (2015) examined 722 students who were mostly categorised as European-Americans (82%). The findings however, were similar across the samples. Among the mostly Caucasian group, O’Hara Armeli and Tennen found that social drinking was positively predicted by all four drinking motives at the situational level, and at the dispositional level, social and coping motives positively and negatively predicted this outcome, respectively. Non-social drinking was positively predicted by coping-motives at the situational and dispositional level and negatively predicted by social and enhancement motives at the situational and dispositional level, respectively. Similar findings emerged among the African American students (O’Hara et al., 2014). This suggests that regardless of a person’s racial background, alcohol use in either a social or non-social setting, appears to be influenced by both their dispositional and situation specific drinking motivation.

In conclusion, these daily-diary findings provide some of the first evidence for the significant role situation-specific drinking motives have both directly (i.e., Linden-Carmichael & Lau-Barraco, 2018) and via interactions with situational factors (O’Hara et al., 2014; O’Hara Armeli & Tennen, 2015) in the prediction of drinking behaviour. Notwithstanding the utility of these findings, daily-diary type methodology can be limited by its reliance on retrospective data collection tools. Indeed, each of these studies required participants to log onto a website and report the associated drinking
variables, 24 hours after the event had taken place. This delay in reporting raises the possibility of imprecise responses; adopting methods that enable more frequent, in-the-moment responses, is essential to understanding what antecedents precede drinking behaviour. Ecological Momentary Assessment (EMA) provides this through repeated sampling and collection of real-time data within the individual’s natural environment (Csikszentmihalyi & Larson, 1987). This in turn, helps to ensure ecological validity, greatly reducing the risk of retrospective bias, pertinent to the daily diary studies (Shiffman, Stone, & Hufford, 2008). The subsequent section will detail the studies that have adopted EMA methods to examine drinking behaviour, within the framework of motives and situational factors.

**Ecological Momentary Assessment**

To address the limitation inherent in daily diary methods (i.e., delayed assessment of drinking-related variables), studies have recently begun using EMA, via participants’ mobile phone device, to achieve a more fine-grained understanding into the dynamics of alcohol use in day-to-day life, hour by hour (e.g., Dvorak, Pearson & Day, 2014; Thrul & Kunstche &., 2016).

The focus of Dvorak and colleagues’ (2014) study was to examine how daytime affective states (i.e., negative and positive) that occur before the drinking event interacted with situation-specific motives (i.e., enhance and cope) to predict drinking subsequent drinking outcomes (i.e., number of drinks and drinking-consequences) on planned drinking days. Contrary to their predictions, daily negative affect was predictive of heavy drinking (not drinking consequences as anticipated) via situational coping motives for both males and females. Moreover, while it was expected that daily positive affect would predict endorsement of situational enhancement motives, which in turn would be associated with drinking problems via alcohol use, this was not found. Rather, for males, experiencing positive affect was predictive of endorsing situational
enhancement motives, which directly related to drinking-consequences (without a mediating effect of alcohol use). These findings are the opposite of those observed in the cross-sectional (for a review refer to Kuntsche et al., 2005) and daily-diary (O’Hara et al., 2014) literature in which coping motives, both dispositional and situation-specific, were related to drinking-related consequences and enhancement motives, both dispositional and situation-specific, were associated with heavy drinking. These findings do suggest that when the affect-regulation model is examined using EMA methodology, the results paint a unique picture in comparison to cross-sectional and daily diary assessments show. Indeed, the process of managing strong positive and negative affect, in the moment, differs from an individual’s memory of how they managed the affect in general and retrospectively. These findings attest to the importance of EMA methodology in the examination of how affect management influences motivated drinking processes, and vice versa.

Thril and Kuntsche (2016) employed an EMA to identify if situational determinants, including situation-specific drinking motives and social interpersonal factors (i.e., number of friends present) coupled with dispositional drinking motives could predict accelerated drinking for 182 young people ($M_{\text{age}}=23.1$ years, $SD_{\text{age}}=3.1$). For males, the number of friends present was the only factor that significantly predicted their hourly alcohol consumption rate. Whereas, for women, this study found a significant interaction between endorsing situation specific coping motives and the number of friends present upon their hourly alcohol consumption rate. A key benefit of this fine-grained assessment is that it has precisely shown differences in drinking outcomes, depending on the active ingredients of the social setting. For males, the results suggest the composition of the social setting, specifically interacting with a large number of friends, as strongly influential in their decision to engage in heavy drinking. Whereas for females, the results suggest a more complicated relationship; those that
endorse situation-specific coping motives are more likely to drink excessively when exposed to social situations with a large number of friends present. This latter finding contrasts the results from cross-sectional investigations (e.g., Cooper, 1994) and daily diary studies (e.g., O’Hara et al., 2014) which have found dispositional and situational coping motives to be predictive of non-social drinking, in females.

In summary, the studies by Dvorak and colleagues and Thrul and Kuntsche revealed findings that contrasted those found in both cross-sectional and daily diary investigations. That is, Dvorak and colleagues found situation-specific coping motives and negative affect interacted to predict heavy drinking (not consequences) and enhancement motives and positive affect interacted to predict drinking-related consequences (not consumption outcomes). Furthermore, Thrul and Kuntsche found that women who endorsed situation specific coping motives, drank more when they were exposed to a social context (rather than a non-social context). As unique as these findings are however, there is only a small paucity of EMA studies to refer to, making it difficult to draw any firm conclusions. Though, given the known issues which undermine the reliability of daily diary studies (i.e., retrospective bias) and the validity of cross-sectional methods (i.e., the aggregation across the situation), it is reasonable to postulate that the unique findings which EMA methodology present, generate a level of insight into drinking behaviour that the latter methods, by their nature, cannot provide. It is argued herein that EMA is the most appropriate methodology, to gain clarity into the unique relationships between situational factors (i.e., affect and social context), drinking motives (i.e., situational and dispositional) and alcohol use, in real time.

This chapter has examined four different lines of evidence to support the novel re-conceptualisation of drinking motives as both a situation-specific and dispositional variable; (i) evidence from studies that examined drinking behaviour (ii) analytic procedures performed by Paul Beaton (iii) daily diary and (iv) EMA studies. Attention
is now directed to future research directions.

**Critique of the Literature and Future Research Directions**

The overarching aim of this chapter was to examine the structure and function of dispositional drinking motives as described in the existing literature. In addressing this, one’s motivation to drink, as conceptualised by the Four Factor Motivational Model (Cooper, 1994), emerged as a key cognitive construct underlying the decisional process of alcohol consumption. Indeed, each of the four drinking motives, measured as dispositional constructs, were shown to share a particular relationship with both alcohol use indicators and adverse drinking-related consequences. For example, positively valanced dispositional drinking motives (i.e., social and enhancement) were shown to be consistently predictive of alcohol consumption indicators (i.e., quantity and frequency), and indirectly associated with adverse drinking-consequences. Whereas, negatively valanced dispositional drinking motives (i.e., coping and conformity) were shown to share a relatively stable relationship with adverse drinking-consequences and rather inconsistent associations to alcohol consumption indicators (i.e., quantity and frequency). Notwithstanding these contributions, a revealed weakness of the motivational model was the operationalisation of drinking motives as being only a dispositional construct – invariant across all situations. Certainly, the four lines of evidence presented made a strong case for the utility in measuring drinking motives as a construct that exhibits both stable-dispositional, and variant-situational qualities. Indeed, sufficient evidence to support this claim comes both indirectly from studies that examined drinking behaviour generally (e.g., Demers et al., 2002) and directly, from analytic procedures (e.g., Beaton, 2014) and empirical investigations using daily diary and EMA methods (e.g., Kuntsche, Otten, & Labhart, 2015). Despite these latter studies progressing the current state of the drinking motivational literature, they are an initial, exploratory step with questions still remaining.
Undeniably, the daily-diary and EMA studies referenced throughout this Chapter have grappled with measuring the drinking situation, in its entirety. Indeed, no study to date has examined how both internal (e.g., affect) and external (e.g., social interpersonal) features of the drinking situation interact with drinking motives, to predict drinking behaviours. Rather, the EMA studies only examined how a single feature of the drinking context (i.e., internal or external) interacted with drinking motives to predict alcohol use. To examine how both internal and external situational features interact with drinking motives to predict alcohol use, the following questions need to be addressed; First, which factors, within the drinking-motivational literature, constitute the ‘drinking situation’? Second, how does one’s motivation to drink, both stable and variant in nature, interact with multiple features of the drinking situation to predict alcohol-related outcomes? With these important questions unaddressed, a strong rationale for the next Chapter is recognised. Indeed, Chapter Three will systematically review the drinking-motivational literature to address these questions. This review is a worthwhile endeavor with great potential benefit, particularly in scaffolding and facilitating development of a framework that can account, simultaneously, for both the stability and variability in drinking behaviours.


Hanson, D. J. (1975). College Students' Reasons for Drinking: Twenty Year Trends. *College Student Journal.*


Kilmer, J. R., Cronce, J. M., & Larimer, M. E. (2013). College student drinking research from the 1940s to the future: Where we have been and where we are going. *Journal of Studies on Alcohol and Drugs, 17*, 26-34.


validity test of drinking to cope measures. Psychology of Addictive Behaviors, 17(4), 303-311


CHAPTER THREE: SYSTEMATIC LITERATURE REVIEW OF DRINKING MOTIVES, THE SITUATION AND DRINKING BEHAVIOURS

Introduction

It has generally been agreed that individuals’ can be motivated to drink by needs that are relatively stable in nature, which in turn, can result in predictable and consistent drinking-related outcomes across situations (e.g., individuals who drink for social motives will consume on average a moderate amount of alcohol, across situations; Cooper, 1994; Kuntsche, Knibbe, Gmel, & Engels, 2005; Kuntsche, Knibbe, Gmel, & Engels, 2006). However, more recently, scholars are questioning this viewpoint and starting to examine the extent to which the drinking motives that young people endorse, vary across situations. In particular, these researchers (e.g., Dvorak, Pearson, & Day, 2014; Mohr et al. 2013; O’Hara, Armeli, & Tennen, 2015) have employed novel methodology that permit assessment of drinking behaviour in the moment (e.g., EMA) and examined; (a) if one’s drinking motivation varies across situations and, (b) whether drinking motives measured within the situation share a stronger relationship with drinking outcomes compared to motives measured as invariant across situations. These studies found that individuals do tend to exhibit motivations for drinking that differ across situations. Furthermore, drinking motives, assessed in the situation were shown to share a stronger relationship with alcohol outcomes, above and beyond dispositional drinking motives (e.g., Linden-Carmichael & Lau-Barraco, 2018; Lau-Barraco, Braitman, Stamates, & Linden-Carmichael, 2016).

What is not as well established is which contextual factors of the situation influence one’s momentary motive to drink, and how this interplay predicts different drinking-related outcomes (e.g., low, moderate and high alcohol consumption)? A systematic review of the relevant literature will assist in addressing this. It is important
to note that the motivational literature has been in a state of change over the prior decade in the following ways; conceptualisation of motives (i.e., dispositional and situation-specific) methods of assessment (i.e., cross-sectional or ecological assessments), drinking situation examined (i.e., affect, location or social influence), and drinking outcomes measured (i.e., moderate alcohol consumption or risky alcohol consumption). A well-integrated understanding of the relationship between drinking motives, situational factors and alcohol use is required.

The aim of this systematic review is to synthesise the findings which examine the relationship between drinking motives, situational factors and alcohol use. Given the diversity in which the literature has conceptualised these factors, the inclusion criterion for this review will be broad. Any study that has explored the relationship between drinking motives (situational and/or dispositional) and situational factors (anything that is measured in the setting of alcohol use) in predicting drinking behaviours (alcohol consumption and/or adverse drinking-related consequences) will be included in the review. However, as a first step, a definition of the situation is provided.

The broader literature highlights that a consistently applied definition of the ‘situation’, is lacking, as essentially any variable that constructs, alters or interacts with the behaviour of interest has been considered relevant to the ‘situation’ (Park & Moro, 2006; Bazire, Brezillon, 2005; Borsari, & Carey, 2001). Without this agreed upon definition, researchers typically interpret and examine the situation as either a function of the observable features of the environment, such as the physical surroundings (i.e., park) within which something exists (e.g., Poland et al., 2006), or the more dynamic and unobservable elements, such as the individual’s affect (e.g., Hussong & Hicks, 2003) or cognitive constructs, such as goals (e.g., Bazire, Brezillon, 2005) that are anchored to that particular situation. These general conceptualisations of the situation are useful as they highlight the array of situational factors that are considered to influence behaviour,
however, this thesis is particularly concerned with the conceptualisation of the situation relevant to motivated drinking. For the purpose of this review, this dissertation draws on Shoda and Wright (1994) and Mischel’s (1988) work and defines the drinking situation as not merely a description of the observable physical properties of the environment, but also containing the unobservable dynamic aspects that are also relevant to the feelings of that particular person at that point in time. The affective components that unfold in a situation are important to consider given their fundamental role in the theoretical underpinnings of the motivational model of both Cox and Klinger (1988) and Cooper (1994), described in Chapter 2.

The subsequent chapter will systematically review the available findings to address the following research questions;

(1) provide an integrated description regarding the conceptualisation and operationalisation of situational factors relevant to motivated drinking and,
(2) review, summarise and describe the relationships between situational factors, drinking motives and alcohol-related outcomes.

**Method**

**Inclusion Criteria**

In order to examine; the conceptualisation of the drinking situation within the drinking motivational literature and the relationship between situational factors, motives and alcohol use, the following inclusion criteria was adopted:

1. The article had to be published in a peer-reviewed journal and written in English
2. The article had to be published between January 1994 and January 2018. Given the review is guided by Cooper’s Four Factor Motivational Model which was published in 1994, only studies published after this data are included.
3. The study had to have assessed how both constructs of interest; drinking motives (dispositional and/or momentary) and situational factors (e.g., social context, affect) influenced drinking-related behaviours (e.g., quantity of alcohol use, frequency of alcohol and/or consequences of alcohol).

4. The article had to examine drinking behaviours among a non-clinical community sample (of any age).

**Literature Search Strategy**

This systematic literature review was carried out in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement guidelines (Liberati et al., 2009). Papers were identified by searching electronic databases: Academic Search Complete, ERIC, Medline, PsycEXTRA, PsycARTICLES, PsycINFO and Psychology and Behavioural Science Collection. All available records were searched starting from January 1994 until January 2018, using the following combination of keywords in the title or abstract of the article: “motive*” OR “reason*” OR “motivation*” AND “context*” OR “drink* environment*” OR “alcohol* environment*” OR “situation*” AND “alcohol” OR “drink*” OR “drunk*” OR “risky drinking” OR “binge drinking”. After the removal of duplicates, 2,556 unique articles were obtained (refer to Figure 3.1). Abstracts were read to assess whether each article met the inclusion criteria. During this process, 2,411 papers did not meet the inclusion criteria and were removed. These papers included; 954 papers that did not examine alcohol as the outcome variable (e.g., tobacco, sex or drugs), 662 papers that had an inappropriate sample (e.g., the sample were dependent drinkers, were polysubstance users), 635 papers that examined situational factors or drinking motives not both and 160 papers that were conceptual in nature and did not examine the relationship between constructs. This left 145 possibly relevant papers, which were read in full whilst applying the inclusion criteria to each paper. During this review process a further 120
papers were excluded as there was no combined examination of drinking motives and situational factors in the prediction of alcohol use. The remaining 25 papers included were identified as being relevant to the review. A manual search for additional papers was conducted by examining the reference lists of all identified papers. From this, an additional 7 papers were relevant. In total, 32 papers were included in this systematic literature review.
Figure 1

Flow Diagram Illustrating the Selection Process for the Systematic Review of the Literature

Literature search Databases: Academic Search Complete, ERIC, Medline, PsycEXTRA, PsycARTICLES, PsycINFO, and Psychology and Behavioural Science Collection

Search results combined after duplicates removed (n = 2,556)

Papers screened on basis of title and abstract

Excluded (n=2,411)
- Papers examining a different outcome from alcohol use (n = 954)
- Papers with an inappropriate sample (n = 662)
- Papers only examining situation or motives (n = 635)
- Papers that were conceptual in nature (n = 160)

Included (n = 145)

Papers screened on basis of full manuscripts

Excluded (n= 120)
- Papers not measuring situation and drinking motives (n = 120)

Included (n = 25)

Papers identified from reference lists of included papers (n = 13)

Papers screened on basis of full manuscripts (n=38)

Excluded (n = 6)
- Papers not measuring context and drinking motives (n = 6)

Included (n = 32)
Results

Overview

The studies reviewed herein show relative consistency in terms of the following:

i. Conceptualisation of the situation: The majority of studies conceptualised the situation by a single factor (21/32; social context, affect or physical location), while a smaller number of studies operationalised the situation as multi-dimensional in nature (11/32; social context and location or social context and affect).

ii. Age of participants: The large proportion of studies (26/32) examined the drinking behaviour of young people under 25 years, and only a small proportion, 6/32 studies, examined adults over 25 years (Abbey, Smith, & Scott, 1993; Engels, Wiers, Lemmers, & Overbeek, 2005; Mohr, Armeli, Tennen, Carney, Affleck & Hromi, 2001; Mohr et al., 2013; Todd, Armeli, Tennen, Carney, & Affleck, 2003; Todd et al., 2005).

iii. Study design: The large proportion of studies employed a longitudinal design using either a daily diary assessment or an EMA (22/32 studies, refer to Appendix 3.1), while the remaining studies employed a cross-sectional design (10/32).

iv. Examination of drinking motives: Only five studies (out of 32) examined situation specific drinking motives (Dvorak, Pearson, & Day, 2014; Ehrenberg, Armeli, Howland, & Tennen, 2016; O’Hara et al., 2014; O’Hara, Armeli, & Tennen, 2015; Todd et al., 2005). The remaining 27 studies examined drinking motives, in a dispositional manner, using survey methodology at one point in time. As such, the results refer to the relationship between dispositional drinking motives, situational factors and alcohol use, unless otherwise specified.
v. Research questions: The studies did differ in terms of the research questions posed including; (i) 4/32 studies examined the extent to which dispositional drinking motives predicted alcohol use in a particular setting (how does social motives predict drinking when with other people? [e.g., Gonzalez, Collins & Bradizza, 2009] refer to Model 1), (ii) 23/32 studies examined the extent to which dispositional drinking motives and situational factors predicted alcohol use (how does coping motives and momentary negative affect predict drinking? [e.g., Hussong, 2007] refer to Model 2) and (iii) 5/32 studies assessed how dispositional drinking motives, momentary drinking motives and situational factors predicted alcohol use (to what extent does social dispositional motives, momentary social motives and being around friends predict heavy drinking? [e.g., Dvorak, Pearson, & Day, 2014] see Model 3).
Figure 2
Three Key Models Depicting How Drinking Motives, the Situation and Alcohol Use have been Examined in the Literature
**Conceptualisation of the Situation**

The drinking motivational literature conceptualised the drinking situation according to three factors: (i) *social, interpersonal* context, defined by whether other people were present or absent in the drinking situation, (ii) *physical location*, the setting of alcohol consumption and (iii) *affect*, the affective state of the individual preceding alcohol use. These three situational categories form the framework guiding the research questions namely: (1) how each of these situational factors have been conceptualised and (2) what relationship these situational factors share with alcohol-related indicators, directly, and also when drinking motives are accounted for. As described above, there are some studies which have conceptualised the drinking situation by more than one factor (i.e. multi-dimensional). The main effects of these studies are included in each of the individual sections below, and the interactions are described in the concluding section.

**Conceptualisation of Situation According to Social Factors**

Out of 32 studies, a total of 16\(^8\) (50%) conceptualised the drinking situation as a function of the social, interpersonal features of the setting. The large majority of these studies (10/16) defined the social situation by who the person was with when they drank; alone or with others (see Appendix 3.1). A smaller subset of studies (3/16) expanded on this by asking whether the companions the individual was with, were drinking (e.g., Cullum, O’Grady, Armeli & Tennen, 2012; O’Hara, Armeli, & Tennen, 2015; Piontek, Kraus, & Rist, 2013) and a paucity of studies (3/16) defined the social situation by the nature of the social interaction, whether it was positive or negative (e.g., Blevins, Abrantes, & Stephens, 2018; Mohr et al., 2001; Mohr et al., 2005). Finally, a large proportion of these studies (11/16) conceptualised the social drinking situation as

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\(^8\) Please note that references of 6 or more studies are not included in parenthesis to facilitate coherence. Please refer to Appendix 3.1 for more information.
multi-dimensional in nature (i.e., the study measured the drinking situation by the social context and an additional situational factor [e.g., momentary affect or physical location of drinking]).

**Social Situation, Drinking Motives and Alcohol Outcomes**

These 16 studies were comparable in terms of the design and participants recruited. In terms of the design, the majority of the studies (10/16) employed a longitudinal design while a smaller proportion (6/16), employed a cross-sectional design (refer to Appendix 3.1). Across 12/16 studies, participants were young adults under 25 years, a smaller minority of studies, 4/16, sampled adults aged 25 years and over (Abbey, Smith, & Scott, 1993; Engels, Wiers, Lemmers, & Overbeek, 2005; Mohr et al., 2001; Mohr et al. 2013). The main effect of the social situation upon drinking motives and alcohol use is presented in the subsequent section, and the interactive effect between social context, affect and the physical location upon motivated drinking (derived from the studies that conceptualised the social context as multidimensional), is presented in a later section.

**Main Finding: Social Situation**

In terms of the direct effect of the social situation upon alcohol use, the majority of studies, 11/16, identified being in a social situation as associated with increased alcohol consumption. An illustrative example comes from Kuntsche, Otten, and Labhart, (2015) who found that being around same-sex friends increased the likelihood of a binge-drinking episode (greater than 4 standard drinks) by 29% for females and 35% for males. Furthermore, Piontek, Kraus, and Rist (2013) found that for the 625 heavy drinking episodes that were reported, 609 of the heavy drinking episodes were during occasions in which others were present. These findings collectively show that being exposed to a context where other people are present is a direct predictor of excessive drinking. In contrast, only one study failed to find a significant direct effect
between being in a social situation and alcohol consumption (e.g., Cullum, O’Grady, Armeli & Tennen, 2012) and four studies did not examine this direct effect (e.g., Blevins, Abrantes, & Stephens, 2018; Cooper, 1994; Gonzalez, Collins & Bradizza, 2009; Terry-McElrath, Stern, & Patrick, 2017).

From the studies that examined the relationship between social factors, drinking motives and alcohol use, the most consistent finding that emerged was that those in a social situation with other people were more inclined to drink if they endorsed social motives (8/16 studies) or enhancement motives (8/16 studies). A smaller degree of studies found drinking in a social situation was predicted by dispositional coping motives (5/16 e.g., Kuntsche, Otten, & Labhart, 2015; Mohr et al., 2001; Mohr et al., 2005; Smit, Groefsema, Luijten, Engels, & Kuntsche, 2015; Thrul, & Kuntsche, 2016) and dispositional and situation-specific conformity motives (4/16 e.g., Kuntsche, Otten, & Labhart, 2015; O’Hara, Armeli, & Tennen, 2015; Piontek, Kraus, & Rist, 2013; Smit, Groefsema, Luijten, Engels, & Kuntsche, 2015). These latter findings tended to be more pronounced for women. Indeed, two studies found that women who endorsed dispositional coping motives were inclined to engage in high level drinking if they were in a social situation and surrounded by other women (e.g., Kuntsche, Otten, & Labhart, 2015) or surrounded by both men and women (Thrul, & Kuntsche, 2016). Similarly, women who endorsed dispositional conformity motives were more inclined to drink in a heavy manner if they were surrounded by other women (Kuntsche, Otten, & Labhart, 2015).

**Main Finding: Non-Social Situation**

In terms of the relationship between drinking alone and alcohol use indicators, the findings suggest that young adults who, on average, drink moderately, are more inclined to drink *less* when they are alone compared to when they are with other people (Mohr et al. 2013; Terry-McElrath, Stern, & Patrick, 2017). For example, O’Hara and
colleagues (2015) found that when alone, young adults with normative drinking behaviours, consumed on average, 3.6 standard drinks ($SD=3$), whereas when they were with others they consumed on average, 5.1 standard drinks ($SD=3.7$). In contrast, Gonzalez, Collins, and Bradizza (2009) found that when people with moderate to high drinking problems, drank alone, it was predictive of heavy drinking. Specifically, Gonzalez and colleagues found that heavy drinkers who typically drank alone, reported drinking 23 standard drinks per week ($SD=14.42$) in comparison to heavy drinkers who typically drank with others only reporting 13 standard drinks per week ($SD=12.14$). Taken together, for individuals who exhibit normative drinking behaviours, drinking alone results in less alcohol consumption in comparison to when drinking with others. Whereas, for those who report problematic drinking behaviours, alcohol consumption when alone may be related to a higher quantity of alcohol use, in contrast to when drinking with others.

A total of 8/16 studies examined the relationship between drinking in a non-social situation, drinking motivations and alcohol-use indicators (refer to Appendix 3.1). The common finding that emerged across a large proportion of these studies was that those who endorsed dispositional coping motives were more inclined to drink alone, and in doing so, consume a large quantity of alcohol (7/16 studies). An illustrative example comes from Gonzalez and colleagues who identified that endorsing dispositional coping motives significantly related to drinking heavily in a solitary setting ($r=.27$).

**Conceptualisation of Situation According to the Location**

A total of 7 out of 32 studies conceptualised the drinking situation by the physical location in which alcohol was consumed (refer to Appendix 3.1). The large majority of these studies (5/7) conceptualised the drinking location as either ‘drinking at home’ or ‘drinking away from home’ (e.g., Cooper, 1994; Engels, Wiers, Lemmers, &
Overbeek, 2005; Kuntsche, Otten, & Labhart, 2015; Mohr et al., 2001; Piontek, Kraus, & Rist, 2013). A smaller subset of studies (2/7) conceptualised the drinking location only by whether drinking occurred ‘away from home’, such as at a party (O’Hara, Armeli, & Tennen, 2015) or during a day time activity (Terry-McElrath, Stern, & Patrick, 2017). Finally, all of the studies reviewed (7/7) conceptualised the drinking situation as multidimensional in nature examining both the physical location of alcohol use and the social, interpersonal features anchored within the location.

**Location, Drinking Motives and Alcohol Outcomes**

The seven studies that examined the relationship between physical location, drinking motives and alcohol-related outcomes were comparable in terms of the design and participants recruited. In terms of the design, the majority of the studies (4/7) employed a longitudinal design (e.g., Kuntsche, Otten, & Labhart, 2015; Engels, Wiers, Lemmers, & Overbeek, 2005; Mohr, Armeli, Tennen, Carney, Affleck & Hromi, 2001; O’Hara, Armeli, & Tennen, 2015), while a smaller proportion of studies (3/7) employed a cross-sectional design (e.g., Cooper, 1994; Piontek, Kraus, & Rist, 2013; Terry-McElrath, Stern, & Patrick, 2017). Across 5/7 studies, participants were young adults under 25 years (e.g., Cooper, 1994; Kuntsche, Otten, & Labhart, 2015; O’Hara, Armeli, & Tennen, 2015; Piontek, Kraus, & Rist, 2013; Terry-McElrath, Stern, & Patrick, 2017), while a smaller minority of studies, 2/7, sampled adults aged 25 years and over (e.g., Engels, Wiers, Lemmers, & Overbeek, 2005; Mohr et al., 2001). The main effect of physical location upon motivated drinking is presented in the following section, and the interactive effects between the physical location the social, interpersonal context and its effect upon motivated drinking is presented in a later section.

In regard to the direct relationship between the physical location of alcohol use and alcohol-related indicators, the most consistent finding was that public locations that serve alcohol (i.e., pubs, nightclubs, parties) was the most conducive location to heavy
drinking among young adults (Cooper, 1994; Engels, Wiers, Lemmers, & Overbeek, 2005; Terry-McElrath, Stern, & Patrick, 2017). For example, Engels’ and colleagues found that when young adults consumed alcohol at a bar they consumed on average 5.11 (SD=4.07) standard drinks, in comparison to drinking at home resulting in 2.09 (SD=1.60) standard drinks.

The collective pattern of findings shows drinking away from home (e.g., bars and parties) as related to dispositional enhancement, social and conformity motives (4/7; Cooper, 1994; Engels, Wiers, Lemmers, & Overbeek, 2005; Kuntsche, Otten, & Labhart, 2015), and situation-specific enhancement and social motives (O’Hara, Armeli, & Tennen, 2015). Whereas, drinking at home was most consistently predicted by dispositional (2/7; Cooper, 1994; Mohr et al., 2001; O’Hara, Armeli, & Tennen, 2015) and situation-specific coping motives (1/7; O’Hara, Armeli, & Tennen, 2015). It is important to note that 2/7 studies found drinking during a party was predicted by dispositional coping motives (Engels, Wiers, Lemmers, & Overbeek, 2005; Terry-McElrath, Stern, & Patrick, 2017). This finding is particularly noteworthy as it contrasts Cooper’s (1994) results in which drinking in a public setting was most significantly predicted by dispositional social or enhancement motives.

**Conceptualisation of the Situation According to Affect**

Twenty of 32 papers (62%) investigated the relationship between momentary affect (e.g., sadness, happiness), drinking motives and alcohol use (refer to Appendix 3.1). There was some degree of variability in how affect was measured but typically, most studies used pre-existing validated instruments. In particular, five studies used the 10-item Positive Affect and Negative Affect Schedule (PANAS) short form (Arbeau, Kuiken & Wild, 2011; Littlefield, Talley & Jackson, 2012; Mohr et al., 2005; Park, Armeli, & Tennen, 2004; Read, Wood, Kahler, Maddock, & Palfai, 2003) and three studies applied the expanded form, PANAS-X, which includes 60 affective loaded items.
(e.g., Dvorak, Pearson, & Day, 2014; Hussong, 2007; Hussong, Galloway & Feagans, 2005). A total of five studies employed measures adapted from the PANAS and the Mood Circumplex model (e.g., Armeli, Todd, Conner & Tennen, 2008; Ehrenberg, Armeli, Howland, & Tennen, 2016; Gautreau, Sherry, Battista, Goldstein, & Stewart, 2015; Mohr et al., 2013; Todd, Armeli, Tennen, Carney, & Affleck, 2003). Four studies developed their own scale (e.g., Abbey, Smith, & Scott, 1993; Collins, Pencer, & Stewart, 2017; Grant, Stewart & Mohr, 2009; Todd et al., 2005). Three studies used alternate measures of affect including the State and Trait Anxiety Inventory (Fitzgerald & Long, 2012) or the Inventory of Drinking Situation form (Blevins, Abrantes, & Stephens, 2018; Goldsmith, Smith & Howe, 2009). Although affect was typically measured by the PANAS, which assesses both positive and negative affect, 7 out of 20 studies focused exclusively on the role of negative affect in the process of motivated alcohol use. As a result, there is less information regarding the relationship between positive affect, motives and alcohol use. Finally, only 4/20 studies examined the individual’s affect and an additional feature within the drinking situation (i.e., multidimensional assessment of the situation, Abbey, Smith, and Scott, 1993; Blevins, Abrantes, & Stephens, 2018; Mohr et al., 2005; Mohr et al., 2013).

**Affect, Drinking Motives and Alcohol Outcomes**

The 20 studies that examined the relationship between momentary affect, drinking motives and alcohol-related outcomes were comparable in terms of the design and participants recruited. 14/20 studies employed a longitudinal design in the form of a daily diary assessment (7/14) or an EMA (7/14). The remaining studies (6/20) employed a cross-sectional design (refer to Appendix 3.1). The majority of studies sampled young adults under 25 years (16/20), while 4/20 studies sampled participants over 25 years (e.g., Abbey, Smith, & Scott, 1993; Mohr et al. 2013; Todd, Armeli, Tennen, Carney, & Affleck, 2003; Todd et al. 2005). The main effect of negative and
positive affect and its relationship to drinking motives and alcohol use is partitioned and presented below. The interactive effect between affect and social contextual factors upon motivated drinking is presented in a later section.

**Main Finding: Negative affect**

Negative affect was shown to be a direct predictor of alcohol-related outcomes in a small subset of the reviewed studies (5/20 e.g., Armeli, Todd, Conner & Tennen, 2008; Dvorak, Pearson, & Day, 2014; Grant, Stewart & Mohr, 2009; Mohr et al., 2005; Park, Armeli, & Tennen, 2004). An illustrative example comes from Mohr et al., (2005) who found for each additional unit increase in daytime negative mood, drinking increased by a factor of 1.53, or 53%. As striking as these findings are, a large number of studies either did not examine the direct effect of negative affect upon alcohol use (8/20 studies) or found no significant relationship between negative affect and alcohol-related outcomes (7/20). For example, Ehrenberg and colleagues found that in a sample of 722 young adults, the correlation between negative affect and alcohol consumption was extremely low at $r=0.06$ and insignificant.

The guiding framework for the investigation between negative affect, motives and alcohol use has been the self-medication theory which posits that those who are intrinsically motivated to drink for coping motives will be more likely to consume alcohol when experiencing negative affect (Hall & Queener, 2007). A total of 13/20 studies obtained confirmatory findings for this self-medicating hypothesis (refer to refer to Appendix 3.1 for more information). To illustrate Todd et al., (2003; 2005) found the relationship between being bored and drinking was positively moderated by dispositional coping motives. Of these 13 studies the majority (10 studies) sampled participants who were considered ‘normal’ drinkers (e.g., consumed alcohol on two or less days per week) and these studies varied in their operationalisation of negative affect including; negative affect generally (6/13), anxiety (3/13), sadness (2/13), stress (1/13),
and boredom (1/13). A smaller minority of studies obtained findings that conflicted the self-medication hypothesis. Specifically, Ehrenberg, Armeli, Howland, and Tennen, 2016 found no significant relationship between situation-specific coping motives, negative affect and alcohol use and Park, Armeli, and Tennen, 2004 found no significant relationship between dispositional coping motives, negative affect and alcohol use. Furthermore, 3/20 studies obtained findings that contradicted the self-medication hypothesis (e.g., Hussong, Galloway & Feagans, 2005; Littlefield, Talley & Jackson, 2012; Mohr 2013). An illustrative example comes from Hussong et al., who found those who scored high on dispositional coping motives were less likely to drink on days marked by elevated sadness. In comparison, those who exhibited lower dispositional coping-motive scores were more likely to drink when experiencing high negative affect, such as hostility.

**Main Finding: Positive Affect**

While there were a smaller number of studies that examined the relationship between positive affect and motivated drinking (12/20), a total of five studies identified a direct relationship between positive affect and alcohol use (e.g., Armeli, Todd, Conner & Tennnen, 2008; Dvorak, Pearson, & Day, 2014; Gautreau, Sherry, Battista, Goldstein, & Stewart, 2015; Littlefield, Talley & Jackson, 2012; Mohr et al., 2005), 4/12 studies did not examine the direct relationship between positive affect and alcohol use (e.g., Arbeau, Kuiken & Wild, 2011; Blevins, Abrantes, & Stephens, 2018; Collins, Pencer, & Stewart, 2017; Mohr et al., 2013) and 3/12 studies found no relationship between positive affect and alcohol use (Ehrenberg, Armeli, Howland, & Tennen, 2016; Park, Armeli, & Tennen, 2004; Todd et al., 2005).

In terms of the relationship between positive affect, drinking motives and alcohol outcomes, 6/12 studies found that those who experienced positive affect and endorsed enhancement motivation (both dispositional and situation-specific) were either
more likely to consume a high level of alcohol (e.g., Arbeau, Kuiken & Wild, 2011; Blevins, Abrantes, & Stephens, 2018; Mohr, et al., 2005; Mohr et al. 2013) or experience adverse, drinking-related consequences (Dvorak, Pearson, & Day, 2014; Gautreau, Sherry, Battista, Goldstein, & Stewart, 2015). For example, Mohr and colleagues (2013) found that those with stronger dispositional enhancement motives drank more excessively on days with relatively more positive affect in comparison to those who exhibited weaker enhancement drinking motives.

Findings from Studies that Investigated the Situation as Multidimensional

A number of studies (11/32) investigated the drinking situation as a multi-dimensional construct rather than a single-dimensional construct and thus provide some insight into the interactive effects between situational factors upon motivated drinking (refer to Appendix 3.1). Most commonly (7/32), these studies simultaneously examined physical locations (i.e., bar, party, home) and related social factors (i.e., if they were with other people or alone). The most common finding that emerged from these studies was that young adults who endorsed social or enhancement motives, at the dispositional level, were more inclined to drink in a heavy manner if they were away from home (physical location) and were also with other people (social situation; Kuntsche, Otten, & Labhart, 2015; O’Hara, Armeli, & Tennen, 2015). These studies also revealed that young adults who endorsed dispositional coping motives were more inclined to drink if they were at home (physical location) and alone (non-social situation; Mohr et al., 2001; O’Hara, Armeli, & Tennnen, 2015).

A total of 4/32 studies examined the drinking situation by both social contextual factors and affect (Abbey, Smith, & Scott, 1993; Blevins, Abrantes, & Stephens, 2018; Mohr et al., 2005; Mohr et al., 2013). A consistent finding that emerged from these studies was that individuals who drank for dispositional enhancement motives were more inclined to drink if they were with other people and experienced relatively high
levels of positive affect (Mohr et al. 2005; Mohr et al. 2013). Interestingly, young adults who endorsed dispositional coping motives were more inclined to drink if they were surrounded by other people and experiencing negative affect (Abbey, Smith, & Scott, 1993; Mohr et al. 2013).

It is important to note that 5/11 studies that conceptualised the drinking situation by more than one factor, did not examine the interactive effects of the situational factors (e.g., social interpersonal context and location) upon motivated drinking (Blevins, Abrantes, & Stephens, 2018; Cooper, 1994; Engels, Wiers, Lemmers, & Overbeek, 2005; Piontek, Kraus, & Rist, 2013; Terry-McElrath, Stern, & Patrick, 2017).

**Discussion**

To date, no study has systematically reviewed the drinking motivational literature to examine the combined effect that drinking motives and situational factors have upon drinking behaviours. Therefore, the aim of this systematic review was to synthesise these findings. In doing so, this research endeavoured to; (1) provide an assimilated description regarding the conceptualisation and operationalisation of situational factors within the drinking motivational literature and, (2) review, summarise and describe the relationships between situational factors, drinking motives and alcohol-related outcomes.

Three situational factors emerged as relevant to motivated drinking: *social interpersonal factors, physical location* and *affect*. Furthermore, findings from this systematic review indicate that these factors explain significant variability in both endorsement of drinking motives and alcohol-related indicators. More specifically, internal affective states of the individual (e.g., negative affect) were strongly associated with coping motives and related to more habitual drinking. Whereas factors external to the individual, social and interpersonal (e.g., who the person is with) and location (e.g., a party) were associated with social and enhancement drinking motives and more
episodic—but infrequent—drinking (e.g., Mohr et al. 2001).

A summary of each of the research questions which includes a conceptualisation of situational factors (i.e., social, location and affect; research question 1) and the relationship between each of the three situational factors and alcohol use directly and via drinking motives (research question 2), will be detailed below. This Chapter will conclude with future research directions.

**Social Situation: Conceptualisation and Findings**

Three key findings relevant to the social situation within the drinking-motivational literature emerged. First, the conceptualisation of the social situation was relatively consistent across studies, partitioned into being alone or with other people; second, individuals were inclined to drink in both a social and non-social situation, though the amount of alcohol consumed, differed depending on the type of drinker they were (i.e., moderate or heavy); finally social and enhancement motives were associated with alcohol use in a social situation and coping and conformity motives were associated with alcohol use in a non-social situation. These findings are explained in detail below.

Within the drinking-motivational literature, the conceptualisation of the social situation was typically defined by interpersonal factors, who the person was with when they were drinking; with other people (social context) or alone (non-social context). A smaller subset of studies conceptualised the social situation of the drinking situation by the behaviours of other people (i.e., how much alcohol other people in the situation were drinking). Therefore, there is clear homogeneity in how the social situation has been defined. This consistency is important for two reasons; first it allows researchers to replicate and validate the findings across studies as the measurement of ‘social situation’ is constant, and second; it highlights the significance of examining who the person is with when drinking, evidently there is agreement in the literature that this is a
construct which effects drinking behaviour.

In terms of the effect social interpersonal factors had upon drinking behaviours directly, the review found that both social and non-social situations were related to alcohol consumption. The strength of this relationship however, differed depending on the type of drinker of the person (i.e., non-problematic or problematic). In particular, those who exhibited a healthy relationship with alcohol were shown to be more inclined to drink, excessively, when exposed to situations that were social in nature, rather than non-social in nature. In contrast, individuals who were considered ‘problem drinkers’, consumed more alcohol when exposed to non-social situations, as opposed to social situations. These findings are supported by a body research within the alcohol literature that highlights the influence peer norms have (Brooks-Russell, Simons-Morton, Haynie, Farhat, & Wang, 2014; Martens et al., 2006). Indeed, individuals use the perception of peer norms as a standard in which to compare their own drinking behaviours to (Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007). The difference however, is that those without drinking problems tend to overestimate the prevalence of heavy drinking by other people in the situation, and in turn conform by drinking excessively (e.g., Song, Smiler, Wagoner, & Wolfson, 2012). Whereas, those who struggle to control their alcohol consumption, tend to underestimate the amount of alcohol that other people drink, in comparison to their own, and this can create feelings of shame and embarrassment (e.g., Cunningham, Neighbors, Wild, & Humphreys, 2011). In turn, problematic drinkers are seemingly more comfortable drinking in an excessive manner, in non-social, rather than social settings, as there is a lack of norms or pressures to conform to drinking-related standards.

In examining the interactive effect between drinking motives and the social setting upon alcohol use, the large majority of studies only measured bivariate correlations, so there are limitations in the conclusions that can be drawn. However, the
findings from these studies (e.g., Gonzalez, Collins & Bradizza, 2009) and the small paucity who examined the moderating effect of drinking motives (e.g., Smit, Groefsema, Luijten, Engels, & Kuntsche, 2012), suggest that positively-valanced drinking motives (i.e., enhance and social) are most often reported by young adults when they drink in a social setting. This is not to suggest that negatively-oriented drinking motives were unrelated to drinking in a social situation. Certainly, a subset of studies found that for females, being in a social situation with other people was related to higher levels of alcohol use, mediated by coping motives. These findings suggest that females may find it more difficult to socialise with other people (as compared to males), experience undesirable affect (e.g., anxiety) and in turn, drink as a way to cope with this. Though, without an examination into the affective state that both males and females experience within particular social drinking settings, it is difficult to confirm this prediction.

Drinking in a non-social situation, without other people present, was most consistently predicted by coping motives. This finding is supported by a wealth of historical research (i.e., Cooper, 1994; Cooper, Russell, & George, 1988; Cooper, Russell, Skinner, & Windle, 1992; Cox & Klinger, 1988) which revealed coping motives as predictive of alcohol use in isolated settings. In conjunction with the direct findings described above, which explained—among those with a drinking problem there is a positive association between being in a non-social situation and consuming a high quantity of alcohol—these findings extend upon that by highlighting the effect of coping motives. Indeed, it appears that irrespective if the individual has a drinking problem (e.g., Gonzalez, Collins, & Bradizza; 2009; Mohr et al., 2001) or not (e.g., Blevins, Abrantes, & Stephens, 2018; O’Hara et al., 2014) the literature reveals that if the individual is alone, and they endorse coping motives, they are more inclined to consume a high quantity of alcohol, in contrast to if they don’t endorse coping motives.
The operant construct here being coping motives, which is likely activated in response to an undesirable state such as negative affect. Further examination is required that examines the extent to which affect mediates the relationship between drinking motivations and alcohol use in a social and a non-social situation.

**Location: Conceptualisation and Findings**

The second situational factor that emerged as relevant within the drinking-motivational literature was the physical location of the drinking setting. The conceptualisation of this construct was simply defined by whether the location was a private residence or public venue. The relationship between the drinking location and alcohol use revealed that a higher quantity of alcohol was consumed in public rather than private locations. In terms of the interactive effect of motives; enhancement motives were consistently associated with drinking in public settings, and coping motives, less consistently so, were predictive of drinking in a private residence. Each finding is now explained in detail.

The studies reviewed herein consistently conceptualised the drinking location by whether the possession of the setting was external to the individual, public drinking venues (i.e., nightclubs and bars) or internal to the individual, private residences (i.e., home, house parties; refer to Appendix 3.1). It is noteworthy that all the studies within the review that examined the physical location of alcohol use, also measured the social context of the setting (i.e., if they were with other people or alone within that location; e.g., Kunstche & Kuendig, 2012; Mohr et al., 2001). This suggests that the conceptualisation of the location of alcohol use should also ensure the social, interpersonal features of the situation are accounted for. This is an important consideration for future research studies as ostensibly the meaning and effect of the physical location of the drinking setting is dependent, in part, on the interpersonal features attached to that particular location. For example, the location of a nightclub,
does not represent the same context, with the same social script and norms of behaviour if nobody else is present.

In terms of the relationship between location of drinking and subsequent alcohol use, this review found that when people were exposed to public settings that served alcohol, they were more inclined to engage in heavy drinking, than if they were in a private residence, such as at home. Moreover, drinking in a public setting was most strongly associated with positively oriented drinking motives (i.e., social motives). In evaluating these findings, it appears that the conceptualisation of the physical setting of alcohol use may have been overly simplistic. That is, it may not be the public location that stimulates heavy drinking practices but rather a function of broader factors—such as the availability of alcohol and drinking norms—within this setting (e.g., Jones-Webb, et al., 1997; Sher, Bartholow & Nanda, 2001).

Consistent with earlier research (Cooper, 1994; Cooper, Russell, Skinner & Windle, 1992), being in a non-public setting—such as at home—was most commonly predicted by coping motives. However, it should be noted that only three out of seven studies within this review revealed this relationship. A potential reason for this inconsistent finding is that the internal dynamics of the individual, their affect, mediated the relationship between coping motives and being at home. Put simply, young people may be motivated to drink at home, to cope, if they are also experiencing negative affect. This claim is supported by the theoretical proposition of the motivational model which describes the function of coping motives to soothe and reduce the experience of negative affect (Cooper, 1995; Cox, & Klinger, 1988). However, no study to date has examined this interaction between situation-specific motives, affect and drinking at home, making it difficult to draw firm conclusions.

**Affect: Conceptualisation and Findings**
Finally, the third situational factor considered relevant within the drinking-motivational literature was the affective state, that varies within the individual, preceding or during the drinking occasion. In conceptualising affect, the literature tended to do so broadly, using negative and positive affect, rather than their specific components (e.g., stress, sadness, happiness, relaxed). The findings showed that experiencing both negative and positive affect was related to alcohol use, directly. Moreover, the relationship between positive affect and alcohol use was consistently mediated by enhancement motives, whereas the association between negative affect and alcohol use was found, by some studies, to be influenced by coping motives. These findings are described in the section below.

Studies within the drinking-motivational literature were more focused on conceptualising and examining the role of negative affect, with a smaller proportion of studies conceptualising and examining the role of both negative and positive affect. In light of the findings of the review, however, it is surprising that positive affect was not more of a focus of enquiry. Indeed, a substantial number of studies—that did examine positive affect—found a strong relationship to alcohol-related outcomes directly. This finding is supported by prior research, beyond this review, which find individuals reporting high levels of positive affect as more likely to initiate alcohol use (e.g., Cooper, Frone, Russell, 1995; Crooke, et al., 2013; Hussong, Hicks, Levy & Curran, 2001; McCollam, Burish, Maisto & Sobell, 1980) and continue drinking (Molnar, Busseri, Perrier & Sadava, 2009; Van Tilburg & Vingerhoets, 2002) as opposed to when experiencing neutral affect (i.e., not particularly happy or sad). In sum, a misconception exists among some researchers that it is only negative affect that drives drinking behaviours (Fitzgerald & Long, 2012; Goldsmith, Tran, Smith & Howe, 2009), the findings from this review highlight this viewpoint is not well-substantiated.

Consistent with the writings of Cooper (1995), enhancement motives were
shown to interact with the relationship between positive affect and alcohol use. Indeed, people who endorsed enhancement motives and were experiencing positive affect were more inclined to consume a higher quantity of alcohol compared to people who were not drinking under these circumstances. Evidently, people who are motivated to drink for enhancement motives view alcohol as a mechanism to *enhance* their current experience. This desire is clearly amplified when they are in a state of desirable affect, in which they appear to be driven to want to preserve this feeling, through the use of alcohol.

In terms of the relationship between negative affect, drinking motives and alcohol use, the findings identified were complex. Whilst daily negative affect (e.g., anxiety) was shown to directly relate to subsequent drinking, the interactive effect of coping motives on this process was mixed. Indeed, consistent with the Self-Medicating Hypothesis (SMH), coping motives were shown to moderate and mediate the relationship between negative affect and alcohol use for heavy drinkers (e.g., Hussong 2007; Todd, Armeli, Tennen, Carney & Affleck, 2003 etc.), while only a single study identified this association for normative drinkers (i.e., Mohr et al., 2005). The SMH helps to understand this disparity between the two types of drinkers. Indeed, the SMH argues that heavy drinkers reflect an inability to manage negative affect due to a lack of wider, more functional coping mechanisms (Hussong, Hicks, Levy & Curran, 2001; Khantzian, 1985). In turn, they are particularly sensitive to the negative-response dampening effect alcohol consumption provides (Khantzian, 1997; Swendsen, et al., 2000). Taken together, it is the lack of functional coping mechanisms coupled with sensitivity to alcohol use, which explains why heavy drinkers are at an increased risk of characteristically relying on alcohol to cope with undesirable affective states. Whereas, the theory argues that normative drinkers are less inclined to exhibit this style of maladaptive drinking (i.e., drinking to cope when experiencing negative affect) as they
are typically able to draw on wider, more functional resources, such as social support and problem-focused strategies, when unwanted affect arises (Cooper, Russell & George, 1988; Tennen, Affleck, Armeli & Carney, 2000).

**Situation Measured as Multidimensional: Conceptualisation and Findings**

A small subset of studies conceptualised the drinking situation as multidimensional in nature (i.e., by more than one factor), measuring social context and the location of alcohol use or the social context and the individual’s affective state. In contrast to studies that conceptualised the drinking situation by a single factor, these studies that conceptualised the situation as multidimensional in nature, were shown to share a unique relationship with drinking motives, and alcohol use.

Studies within the review that measured more than one feature of the drinking situation, most commonly examined both the social, interpersonal context and the physical location, of alcohol use. As described previously, assessing the physical location in which the social, interpersonal context is anchored to is necessary to correctly operationalise what the drinking situation is (e.g., a nightclub without other people present represents a different situation compared to a nightclub with other people present). In terms of the findings from these particular studies, distinct relationships with drinking motives and alcohol use were identified. Specifically, when young adults were with other people (social situation) and in a public residence (physical location), they were at an increased risk of heavy drinking if they endorsed social or enhancement motives. Whereas, young adults who were at home (physical location) and alone (non-social situation) were more inclined to drink, excessively, if they endorsed coping motives. These results suggest that there may be an affective component (e.g., positive or negative affect) embedded within these situations, that explain these results. Indeed, individuals who drink for enhancement motives, within these social situations, presumably do so because they are experiencing desirable affect (i.e., enjoyment or fun)
and wish to preserve such feelings. Whereas those who drink to cope, are seemingly triggered by some type of aversive emotion and appear to feel more comfortable drinking in the privacy of their home, where other people are not present to judge or criticise. However, as noted several times throughout this discussion, without an explicit test of the interaction between these three situational factors it is impossible to confidently conclude these assumptions.

An even smaller number of studies conceptualised the drinking situation by both social contextual features (i.e., who they are with) and the affective state of the individual at the time of drinking (i.e., negative and positive). A consistent finding that emerged from these studies was that individuals who were with other people (social context) and experienced relatively high levels of positive affect (affect) were more inclined to drink if they also endorsed enhancement motives. Interestingly, when young people experienced negative affect (affect) and were surrounded by other people (social context), they were more inclined to drink if they endorsed coping motives. While the underpinnings of the motivational model, and other studies have suggested that drinking to cope is not activated in social settings with other people (e.g., Cooper, 1995), these studies suggest that it is not necessarily the social context that triggers coping drinking motivation but rather the individual’s momentary affective state. As such, if we are wanting to know precisely why a person is drinking, within a particular situation, it is essential we also account for how they are feeling within that situation.

Limitations and Future Research Directions

These findings have informed both Research Question 1 and 2. However, there are two key limitations within the reviewed literature that need to be addressed. First, there is a need to improve the coverage of the conceptualisation of the situation in the drinking-motivational literature. Only a dearth of the studies reviewed conceptualised the drinking situation by more than a single factor (i.e., 11/32), and no study to date, has
conceptualised the drinking situation by all three identified factors (i.e., social context, location and affect). Yet, the findings reviewed herein showed each of the situational factors as predictive of distinct alcohol-use indicators, directly and via drinking motives. Clearly, each situational factor holds influence in the individual’s drinking behaviour. Future research is required to test a comprehensive measure of the drinking situation to ascertain if all three factors, specifically, if both internal dynamics (i.e., affect) and external features (i.e., social characteristics and location) of the drinking situation, are simultaneously predictive of drinking behaviours.

Second, to this point in time, researchers have almost exclusively conceptualised drinking motives as only dispositional in nature, with only 16% of studies examining motives as situation specific. As a result, the findings derived from this review tend to examine how dispositional drinking motives and situational factors, each relate to alcohol use. There is value in this assessment as it informs the correlation between motives and alcohol use, and situational factors and alcohol use, though it limits our understanding of how drinking motives, in the moment interact with situational factors to predict alcohol use. With the small number of studies that have investigated this, no firm conclusions can be derived, however it does appear that there are idiosyncratic interactions at play, when drinking motives within each situation are accounted for (e.g., Dvorak, Pearson, & Day, 2014). Without assessing these complex interactions which appear to function at the situational rather than the individual level, inconsistencies will continue to be evident. Future research is needed that examines how both dispositional and situation specific drinking motives, interact with each of these situational factors to predict drinking-related behaviours.

**Conclusion**

Evidently research that incorporates, real time assessment to examine the association between drinking motives and situational factors is needed. To address this,
the next Chapter will employ EMA methodology to examine how drinking motives (dispositional and situation-specific) interact with the three identified situational factors to predict drinking behaviours among young people, of which is a significantly novel contribution to the literature. Examining both situational and dispositional factors, via a near real time assessment, will allow for a more fine-grained examination of the predictors underlying risky drinking, and ultimately contribute to clarifying which situational factors should be targeted by interventions.

References


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### Appendix 3.1

Summary of the Studies Comprising the Systematic Review: Social Context only \((n=5)\)

<table>
<thead>
<tr>
<th>Authors</th>
<th>Design</th>
<th>Aim</th>
<th>Sample</th>
<th>Method</th>
<th>Alcohol Assessment</th>
<th>Context Assessment</th>
<th>Drinking Motives Assessment</th>
<th>Findings</th>
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</thead>
<tbody>
<tr>
<td>Smit, Groefsema, Luijten, Engels, &amp; Kuntsche, 2015</td>
<td>Longitudinal (EMA)</td>
<td>To examine whether drinking motives moderate the association between the social context and alcohol use</td>
<td>197 participants (51.3% men) with a Mean age of 20.77 years (SD = 1.73)</td>
<td>Participants completed; (1) a baseline questionnaire of drinking motives and, (2) for 5 weekends (Thurs – Sat) participants were required to report their social context and alcohol use every hour from 9:00pm to 1:00am</td>
<td>Using the EMA participants reported the number of drinks consumed within the previous hour</td>
<td>The context of alcohol use was assessed by the number of male and female friends present in the drinking situation</td>
<td>All four drinking motives were assessed using the DMQ-R (Cooper, 1994)</td>
<td>Women who endorsed enhancement motives were more likely to drink when surrounded by a number of male friends. Men with higher levels of coping motives were associated with a higher number of drinks when female friends were present or they were alone. Men who scored high on conformity motives consumed fewer drinks when more female friends were present.</td>
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<tr>
<td>Thrul, &amp; Kuntsche, 2016</td>
<td>Longitudinal (EMA)</td>
<td>Examined whether the interaction drinking motives and the social context can predict alcohol consumption</td>
<td>The sample consisted of 183 participants (53.0 % female) with a mean age of 23 years (SD=3.1)</td>
<td>Participants completed; (1) a baseline questionnaire of drinking motives and, (2) for 5 weekends (Thurs – Sat) participants were required to report their social context and alcohol use every hour from 8:00pm to 12:00am</td>
<td>Using the EMA participants reported the number of drinks consumed within the previous hour</td>
<td>The context of alcohol use was assessed by asking participants how many people they were with</td>
<td>All four drinking motives were assessed using the DMQ-R (Cooper 1994)</td>
<td>Women who endorsed coping motives, shared a positive relationship between the number of friends present and the amount of alcohol consumed</td>
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<tr>
<td>Study</td>
<td>Design</td>
<td>Research Question</td>
<td>Sample Size</td>
<td>Participants</td>
<td>Data Collection Methodology</td>
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<td>Cullum, O'Grady, Armeli &amp; Tennen, 2012</td>
<td>Longitudinal (daily-diary)</td>
<td>The relationship between drinking motives and drinking in social settings.</td>
<td>523 participants (51% men) with a Mean age of 18.8 years (SD = 1.1)</td>
<td>Participants completed; (1) each year for 4 years a baseline survey which measured social and conformity drinking motives and (2) two weeks after the baseline survey, a daily diary study 1 x per day for 30 days which assessed their drinking behaviours</td>
<td>The daily diary assessed how many drinks the individual accepted from others</td>
<td>Social and conformity motives were measured using the DMQ-R (Cooper 1994)</td>
<td>Individuals' who endorsed social motives were more inclined to drink when they were with others' who were drinking</td>
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<tr>
<td>O'Hara, Boynton, Scott, Armeli, Tennen, Williams, &amp; Covault, 2014</td>
<td>Longitudinal (daily-diary)</td>
<td>To examine the relationship between episode-specific drinking motives, social context and alcohol use among African-American young adults</td>
<td>462 participants (59% female) with a Mean age of 20 years (SD = 1.60)</td>
<td>Participants completed; (1) a baseline questionnaire of drinking motives and, (2) a daily diary 1 x per day for 30 days which examined social context, drinking motives and alcohol consumption</td>
<td>Participants reported how many standard drinks they consumed the previous night</td>
<td>The context of alcohol use was examined by asking participants who they were with when they were drinking, “others” or “alone”</td>
<td>Trait-level coping, enhancement and social drinking motives were assessed using the DMQ-R (Cooper, 1994) Episode-specific coping, enhancement and social drinking motives were measured for each evening in which participants reported alcohol use. The items were adapted from the DMQ-R Individuals’ drank for social motives at the trait and episode specific level and enhancement motives at the episode specific level were more inclined to engage in heavy drinking when with others Coping motives at the trait and episode specific level positively predicted heavy drinking when alone</td>
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<tr>
<td>Gonzalez, Collins &amp; Bradizza, 2009</td>
<td>Cross-sectional</td>
<td>The relationship between drinking motives and heavy episodic drinking in different social situations</td>
<td>91 participants (52% female) with a Mean age of 19 years (SD = .74)</td>
<td>Self-report questionnaires were administered to participants which examined the key variables of interest</td>
<td>Alcohol use in the prior 4 weeks was assessed by; number of drinking days, number of standard drinks consumed on a drinking day, and the number of days on which heavy drinking occurred.</td>
<td>All four drinking motives was assessed using the DMQ-R (Cooper, 1994)</td>
<td>Individuals who drank for social or enhancement motives were more likely to drink a heavy amount when they were with others Coping motives was positively predictive of solitary heavy drinking</td>
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</table>
### Appendix 3.1
Summary of the Studies Comprising the Systematic Review: Physical Location only \( (n=0) \)

### Appendix 3.1
Summary of the Studies Comprising the Systematic Review: Affect \( (n=16) \)

<table>
<thead>
<tr>
<th>Authors</th>
<th>Design</th>
<th>Aim</th>
<th>Sample</th>
<th>Method</th>
<th>Alcohol Assessment</th>
<th>Context Assessment</th>
<th>Drinking Motives Assessment</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dvorak, Pearson, &amp; Day, 2014</td>
<td>Longitudinal (EMA)</td>
<td>If positive and negative affect and alcohol use are mediated by coping and enhancement motives</td>
<td>74 participants (58% female) with a Mean age of 21 years SD = 2.07</td>
<td>Participants completed; (1) an online survey of drinking motives and (2) an Ecological Momentary Assessment (EMA) which alerted participants 3 times a day for 21 days to report their affect, drinking motives and alcohol use.</td>
<td>Using the EMA participants reported how many standard drinks they had consumed since the last reporting and if they had experienced any Alcohol Use Disorder (AUD) symptoms (i.e., a loss of control over alcohol use, tolerance or withdrawal)</td>
<td>Using the PANAS-X negative mood was assessed as the mean of anxious, nervous, jittery, irritable, angry, frustrated, down, blue, depressed, and sad. Positive mood was the mean of excited, enthusiastic, energetic, happy, and joyful</td>
<td>Trait-level coping and enhancement drinking motives were assessed using the DMQ at baseline. Episode-specific cope and enhancement motives were assessed daily via the EMA with three items for each subscale from the modified DMQ-R (Grant, Stewart, O’Connor, Blackwell, &amp; Conrod, 2007). Among men and women, a significant, positive relationship between negative daily affect and AUD symptoms was mediated by daily coping motives. Among men, a positive relationship between daytime positive affect and AUD symptoms was mediated via enhancement motives.</td>
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<tr>
<td>Gautreau, Sherry, Battista, Goldstein, &amp; Stewart, 2015</td>
<td>Longitudinal (EMA)</td>
<td>The moderating effect of enhancement, motives on daily, high-arousal positive mood and drinking.</td>
<td>143 participants (74% women) with a Mean age of 20.78 years (SD = 3.36).</td>
<td>Participants completed; (1) a baseline assessment of drinking motives and, (2) a daily diary assessment once a day for 22 days which examined affect and alcohol use.</td>
<td>Using the daily assessment participants reported the number of drinks they had consumed each evening</td>
<td>Using the PANAS and Mood Circumplex participants reported their high and low arousal affect each day rating how much each of the adjectives described their mood; positive high arousal affect = exhilarated, hyper, euphoric</td>
<td>5 drinking motives (coping-depression, coping-anxiety, enhance, social and conform) were assessed using the Modified DMQ-R (Grant, Stewart, O’Connor, Blackwell, &amp; Conrod, 2007). High enhancement-motivated drinkers drank more than low enhancement-motivated drinkers during higher levels of high-arousal positive mood. Low enhancement-motivated drinkers refrained from heavier drinking on days when</td>
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</table>
These items were taken from the PANAS and the Mood Circumplex.

Participants recorded their affect via the EMA using the sadness subscale from the PANAS Expanded Form; sad, blue, downhearted, alone, lonely (Watson & Clark, 1990). The first peak day of sadness occurring in the observation period was coded as the beginning of the survival period for subsequent analyses.

Cope drinking motive was assessed using the DMQ-R (Cooper, 1994) Individuals with higher coping motives were more likely to drink sooner after peak days of sadness.

Greater daily hostility was significantly associated with greater drinking among those reporting low coping motives. Those with high coping motives reported less drinking on days with elevated sadness. Those high in coping motives were more likely
To examine the relationship between drinking to cope, negative affect and alcohol use

98 participants (50% women) with a Mean age of 43 years (SD=8.69)

Participants completed: (1) a baseline questionnaire of drinking motives and, (2) a daily diary 3x per day for 21 days which examined affect, coping motives and alcohol use

Using the daily diary participants reported the number of drinks they had consumed

Using a scale developed for this study affect was assessed by: bored, sad, nervous, angry, lonely and disappointed; and peppy, happy and relaxed. In addition a six-item negative mood composite and a three-item positive mood composite was used.

Cope drinking motivation was assessed using the four-item Use of Drugs and Alcohol subscale of the COPE (Carver et al., 1989)

For each 1 unit increase in trait-level cope motives the odds of reporting that one drank to cope with negative affect increased by 20%

For those with lower trait-level coping motives, happy mood was positively related to drinking


To examine across two studies the relationship between drinking to cope, negative affect and alcohol consumption

Study 1: 83 participants (53% women) with a Mean age of 37 years (SD = 6.65)

Study 1: daily diary assessment 3x per day for 60 days assessed negative affect, stress and alcohol use

Study 2: daily diary assessment 3x per day for 30 days assessed negative interpersonal exchanges, negative affect and alcohol use

Study 1 & 2: Using the daily diary participants recorded the number of alcoholic beverages they consumed for the morning, afternoon, and evening intervals

Study 1: drinking context was examined by; (a) negative affect (bored, nervous, sad) drawn from Larsen and Diener’s (1992) eight-facet mood circumplex, as well as lonely and angry moods and, (b) perceived stress using Cohen, Kamarck, and Mermelstein’s (1983) 4-item version of the Perceived Stress Scale.

Study 2: the same items of negative affect were measured in this study

Study 1 & 2: Drinking to cope was measured using the COPE (Carver et al., 1989) and the RFDQ (Farber et al., 1980) composites

Individuals with low levels of coping motives drank less on days characterized by lonely and bored moods. In contrast, those high in coping motives showed no difference in drinking on days characterized by high or low levels of lonely and bored moods.

Study 2: Individuals who did not endorse coping motives were less likely to drink on occasions with negative affect. Whereas individuals with high levels of coping motives drank more on weekends following work weeks characterized by high levels of boredom
<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Main Findings</th>
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<tbody>
<tr>
<td>Arbeau, Kuiken &amp; Wild, 2011</td>
<td>Longitudinal (daily-diary)</td>
<td>If trait-level coping and enhancement motives moderate the relationship between affect and motivated-drinking. Participants completed: (1) baseline survey of drinking motives, and (2) a daily diary assessment 1 x per day for 14 days which examined mood, alcohol use and motives. Alcohol use was assessed by the daily diary assessment once per day by asking “have you consumed alcohol today?” Response was yes/no. The daily diary assessment measured affect using the Positive and Negative Affect Scale (PANAS; Watson, Clark, &amp; Tellegen, 1988). Positive affect and negative affect were predicted by daily negative affect and negatively by daily positive affect. Trait-level enhancement and coping drinking motives were measured using the DMQ-R (Cooper, 1994). Trait-level motivated drinking was positively predicted by positive affect and trait level enhancement motivation. The relationship between negative affect and daily coping motivated drinking was positively moderated by trait-level coping motives.</td>
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<tr>
<td>Armeli, Todd, Conner &amp; Tennen, 2008</td>
<td>Longitudinal (daily-diary)</td>
<td>If trait-level coping motive moderates the relationship between daily negative mood and weekly drinking. Participants completed: (1) baseline survey of drinking motives and, (2) daily diary assessment 1x per day for 30 days which examined affect and alcohol use. Using the daily diary participants reported the number of drinks they consumed: (1) the previous evening and (2) during the current day. Participants reported their affect from 12 items from the Positive and Negative Affect Schedule and mood circumplex; six items to assess positive mood - excited, enthusiastic, cheerful, happy, content, relaxed and six items to assess negative moods (jittery, nervous, sad, dejected, hostile &amp; angry. Trait coping, social and enhancement drinking motives were measured using the DMQ-R (Cooper, 1994). Social and enhancement motives were aggregated into one subscale. Higher weekly anxiety levels were associated with earlier drinking onset among individuals with high coping motives and later drinking onset among individuals with low coping motives.</td>
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<tr>
<td>Ehrenberg, Armeli, Howland, &amp; Tennen, 2016</td>
<td>Longitudinal (daily-diary)</td>
<td>Whether positive and negative affect during the day predicted subsequent, coping-motivated drinking episodes. Participants responded once a day for 30 days to a daily diary assessment which examined affect, drinking motives and alcohol consumption. Using the daily diary assessment participants reported the number of alcoholic drinks consumed the previous night and up to reporting that day. In the daily diary negative affect was assessed with items “sad,” “dejected,” “anxious,” “nervous,” “angry,” and “hostile.” Positive affect was assessed with items “happy,” “cheerful,” “relaxed,” and “calm. These items were taken from the PANAS and the mood circumplex. Participants reported during drinking events the extent to which they drank for coping motives using the DMQ-R (Cooper, 1994). Drinking for coping motives was positively predicted by daily negative affect and negatively predicted by daily positive affect.</td>
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<td>Author(s)</td>
<td>Study Design</td>
<td>Research Question</td>
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<tr>
<td>Grant, Stewart &amp; Mohr, 2009</td>
<td>Longitudinal (daily-diary)</td>
<td>The extent to which coping-anxiety and coping-depression motives moderate the relationship between daily affect and subsequent drinking</td>
</tr>
<tr>
<td>Littlefield, Talley &amp; Jackson, 2012</td>
<td>Longitudinal (daily-diary)</td>
<td>To examine if coping motives moderate the relation between negative mood and drinking</td>
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</table>
| Park, Armeli, & Tennen, 2004 | Longitudinal (daily-diary) | Whether daily stress-drinking varies as a function of drinking motives | 137 participants (74% women) with a Mean age of 18.72 years (SD=1.02) | Participants completed; (1) a baseline questionnaire of drinking motives and, (2) a daily diary 1x per day for 28 days which examined affect and alcohol use | Participants reported the number of alcoholic beverages they had consumed in the previous evening | Social, enhancement and coping motives were assessed using the DMQ-R (Cooper, 1994). Social and enhancement motives were aggregated into a single construct The results found that neither social/enhancement motives or coping motives significantly moderated the affect-drinking slopes.
<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Aim</th>
<th>Methodology</th>
<th>Findings</th>
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<tbody>
<tr>
<td>Collins, Pencer, &amp; Stewart, 2017</td>
<td>Cross-sectional</td>
<td>The effect of drinking motives and mood induction on laboratory alcohol consumption</td>
<td>81 (55% female) with a mean age of 20.6 years (SD = 1.73)</td>
<td>The first part of the experiment involved participants completing a questionnaire of drinking motives on the computer. Then, participants were randomly assigned to either the positive or anxious mood induction. Following this, a 20-minute taste rating task was used to measure drinking levels in the lab. Alcohol consumption was measured the total volume of alcoholic beverages consumed in the experiment. A scale developed for this study was used to assess affect pre and post the mood induction. Positive mood (cheerful, happy, glad, and pleased) and anxious mood (nervous, anxious, and tense) were assessed.</td>
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<tr>
<td>Fitzgerald &amp; Long, 2012</td>
<td>Cross-sectional</td>
<td>The relationship between drinking motives and negative affect among low, moderate and high-risk drinkers</td>
<td>96 participants (58% female) with a mean age of 21.57 years (SD = 5.38)</td>
<td>A baseline questionnaire examined drinking motives, state-level anxiety and typical alcohol consumption. Alcohol use was assessed using the Comprehensive Drinkers Profile (Miller &amp; Marlett, 1984) The sample were divided into low, moderate and high-risk groups. State based anxiety was examined using the State Trait Anxiety Inventory (Spielberger 1970) All four of the drinking motives were measured using the DMQ-R (Cooper, 1994).</td>
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<tr>
<td>Goldsmith, Tran, Smith, &amp; Howe, 2009</td>
<td>Cross-sectional</td>
<td>The extent to which heavy drinking during occasions of negative affect is predicted by coping motives</td>
<td>782 participants (61% female) with a median age of 19 years</td>
<td>An online questionnaire assessed the key variables of interest. Alcohol use was assessed using the Negative Affect subscale of the Inventory of Drinking Situations - which measures heavy drinking in the past month during occasions of negative affect. Negative affect was measured using the Negative Affect (NA) subscale of the Inventory of Drinking Situations. The NA subscale is composed of three subscales: Unpleasant Emotions, Conflict with Others, and Physical Discomfort. Cope drinking motive was measured using the DMQ-R (Cooper, 1994).</td>
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</tbody>
</table>
To examine if coping motives moderate the relationship between negative affect and alcohol use, 388 participants (56% female) with a Mean age of 18.6 years (SD = 0.56) were included. Participants completed a baseline questionnaire that assessed key variables. Typical quantity and frequency of alcohol consumed each week, over the prior 12 weeks was assessed. Alcohol-related consequences were assessed over the prior 6 months using the Young Adult Alcohol Problems Screening Test. Negative affect was assessed using 10 negative affect items from the PANAS (Watson, Clark, & Tellegen, 1988). Coping motives were assessed using the DMQ-R (Cooper, 1994).

Participants who reported higher coping motives were more likely to experience drinking-related problems if they reported negative affect.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Design</th>
<th>Aim</th>
<th>Sample</th>
<th>Method</th>
<th>Alcohol Assessment</th>
<th>Context Assessment</th>
<th>Drinking Motives Assessment</th>
<th>Findings</th>
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<tbody>
<tr>
<td>Kuntsche, Otten, &amp; Labhart, 2015</td>
<td>Longitudinal (EMA)</td>
<td>Examine if social factors and drinking motives predict heavy drinking on a given evening</td>
<td>164 participants (54.3% female) with a Mean age of 23.2 years (SD=3.1)</td>
<td>Participants completed; (1) a baseline questionnaire of drinking motives and, (2) for 5 weekends (Thurs – Sat) participants were required to report their social context and alcohol use every hour from 8:00pm to midnight</td>
<td>Using the EMA participants reported how many alcoholic beverage they consumed</td>
<td>Participants were required to report; (a) the number of male and female friends present in the drinking event and (b) how much time was spent in various drinking locations</td>
<td>All four drinking motives were assessed using the DMQ-R (Cooper, 1994)</td>
<td>For women who drank for coping motives, the likelihood of heavy drinking was increased if there they were with a large number of female friends. For men who drank for enhancement motives, heavy drinking was positively predicted by the number of male friends present and the amount of time spent at a bar.</td>
</tr>
<tr>
<td>Author(s)</td>
<td>Study Design</td>
<td>Study Title</td>
<td>Sample Characteristics</td>
<td>Methodology</td>
<td>Findings</td>
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<tr>
<td>Engels, Wiers, Lemmers, &amp; Overbeek, 2005</td>
<td>Longitudinal (daily-diary)</td>
<td>The role that trait-level drinking motives have in predicting social and non-social drinking</td>
<td>553 participants (58% male) with a Mean age of 42.17 years (SD = 18.4)</td>
<td>Participants completed; (1) a baseline questionnaire of drinking motives and, (2) a daily diary study once a day for 14 days that measured social context and alcohol use</td>
<td>Alcohol use was measured via the daily diary assessment which asked the number of standard drinks consumed that day. Participants were asked in the daily diary study to select which location best defined their drinking context; (1) alone at home, (2) dinner at home, (3) public drinking places, (4) parties, and (5) during visits from relatives or friends. All four drinking motives were measured using the DMQ-R and social and enhancement motives, and coping and conformity motives, were combined. Social/enhancement motives positively predicted drinking alone.</td>
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<tr>
<td>Mohr, Armeli, Tennen, Carney, Affleck &amp; Hromi, 2001</td>
<td>Longitudinal (daily-diary)</td>
<td>To examine if drinking to cope moderates the relationship between negative interpersonal exchanges and alcohol use</td>
<td>100 participants (55% women) with a Mean age of 33.9 years (SD = 4.6)</td>
<td>Participants completed; (1) a baseline questionnaire of drinking motives and, (2) a daily diary 1x per day for 30 days which examined interpersonal exchanges, social context and alcohol use</td>
<td>Using the daily diary assessment participants recorded the number of drinks they consumed each day. The context of alcohol use was examined by; (1) the location (home or away); (2) whether they were with people or alone, (3) whether they had had positive and/or negative interpersonal exchanges. Coping motive was assessed using the 4-item subscale of the COPE measure (Carver, Scheier, &amp; Weintraub, 1989). Individuals who drank for coping motives were more likely to drink at home alone.</td>
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<tr>
<td>O’Hara, Armeli, &amp; Tennen, 2015</td>
<td>Longitudinal (daily-diary)</td>
<td>To examine the relationship between episode-specific drinking motives and social-contextual factors in the prediction of alcohol use</td>
<td>722 participants (54% female) with a Mean age of 19.3 years (SD = 1.3)</td>
<td>Participants completed; (1) a baseline questionnaire of drinking motives and, (2) a daily diary 1x per day for 30 days which examined social context and alcohol consumption</td>
<td>Participants reported how many standard drinks they consumed the previous night with others and how many consumed alone. The drinking context was examined by; (a) number of social companion’s present, (b) gender makeup of companion’s present, (c) if companions were drinking, (d) how much the companions. All four drinking motives were assessed for each evening that alcohol consumption was reported. The items were adapted. Endorsement of social motives in the episode, was related to higher levels of drinking with others and more frequent party attendance. Endorsement of coping motives in the episode, was positively associated with drinking when alone and negatively related to social drinking.</td>
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<tr>
<td>Study</td>
<td>Design</td>
<td>Purpose</td>
<td>Sample Characteristics</td>
<td>Data Collection Method</td>
<td>Variables</td>
<td>Findings</td>
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<td>Cooper, 1994</td>
<td>Cross-sectional</td>
<td>To validate the Four Factor Motivational Drinking Model</td>
<td>1,243 (50% female) participants with a Mean age of 17.3 years</td>
<td>Face-to-face interviews were conducted which examined drinking motives, alcohol use and abuse and typical drinking contexts.</td>
<td>Alcohol use in the past 6 months was assessed by the following: (a) average number of drinks per occasion, (b) frequency of drinking five or more drinks (c). Participants were asked with whom (e.g., family members, same-sex friends) and where (e.g., at home, at parties) they most frequently consumed alcohol.</td>
<td>All four drinking motives were assessed using the DMQ-R (Cooper, 1994). Drinking for Social motives was positively related to drinking at parties and with mixed-sex friends and negatively to drinking at home, with family and at friend’s home. Drinking for coping motives was positively related to drinking at home. Drinking for enhancement motives was positively related to drinking at friend’s homes and at bars and negatively to parties. Drinking for conformity motives was positively related to drinking at parties and negatively to drinking at bars and at home.</td>
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<tr>
<td>Pontek, Kraus, &amp; Rist, 2013</td>
<td>Cross-sectional</td>
<td>To examine the relationship between social context variables, drinking motives and heavy drinking</td>
<td>1,722 participants (51% female) with a Mean age of 23 years (SD=2.28)</td>
<td>Participants completed a baseline questionnaire that assessed the key variables</td>
<td>Heavy drinking in the past 30 days, was assessed on a beverage-specific quantity frequency index. The context of alcohol use was assessed by; (1) The location where drinking occurred (home), (2) the circumstance for drinking (birthday), (3) whether friends were present, (4) whether the respondent’s partner and/or family members were present (yes or no), (5) the total number of people present and (6) the estimated percentage of people who were drunk.</td>
<td>The likelihood of a heavy drinking episode was increased across the following contexts; birthday or a special party, weekend and when a high percentage of persons present were drunk. Moreover, heavy drinking was more prevalent among respondents who endorsed social or enhancement motives. Participants who endorsed conformity motives were less likely to drink in a heavy manner in a public drinking place as opposed to a private drinking situation.</td>
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<tr>
<td>Terry-McElrath, Cross-sectional</td>
<td>To examine the relationship between drinking</td>
<td>16,902 participants in</td>
<td>Participants completed a baseline questionnaire</td>
<td>Participants reported how many times in the last 2 weeks they had consumed</td>
<td>The physical context of alcohol use was assessed by asking participants to</td>
<td>Participants had higher odds of consuming a risky amount of alcohol (15+ drinks) compared to a</td>
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</table>
Stern, & Patrick, 2017

motives, drinking contexts and alcohol use
12th grade (52% female) that assessed the key variables
5, 10 and 15 drinks in one occasion.
report how often in the prior year they drank at a party during the daytime, in a car, alone and at school
motives were for their alcohol use from the following: social/recreational motives (to have fun), coping (to relax); compulsive use motives (to get through the day); drug effect motives (to increase effects of other drugs); and miscellaneous motives (to sleep)
lower level of alcohol (5-9) if they endorsed coping motives and consumed alcohol in any one of the drinking contexts measured. They were less likely to consume a risky amount of alcohol if they endorsed social/enhancement motives

Appendix 3.1
Summary of the Studies Comprising the Systematic Review: Social Context & Affect (n= 4)

<table>
<thead>
<tr>
<th>Authors</th>
<th>Design</th>
<th>Aim</th>
<th>Sample</th>
<th>Method</th>
<th>Alcohol Assessment</th>
<th>Context Assessment</th>
<th>Drinking Motives Assessment</th>
<th>Findings</th>
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</thead>
<tbody>
<tr>
<td>Mohr, Brannan,</td>
<td>Longitudinal</td>
<td>To examine the relationship between daily</td>
<td>47 participants (51% male) with</td>
<td>Participants completed; (1) a baseline</td>
<td>Using the daily diary assessment,</td>
<td>The drinking context was examined</td>
<td>Three drinking motives were</td>
<td>People with stronger negative-mood–drinks home alone slopes reported</td>
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<tr>
<td>Wendt, Jacobs,</td>
<td>(EMA)</td>
<td>affect, drinking</td>
<td></td>
<td>questionnaire of drinking motives and,</td>
<td>participants recorded the number of</td>
<td>by; (a) if drinking had occurred</td>
<td>assessed, social, enhance and cope,</td>
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<td>drinks they consumed</td>
<td>at home alone or away with others;</td>
<td>(b) 10 positive and</td>
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<td>(b) 10 positive and</td>
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Wright, & Wang, 2013

motives and alcohol use

a Mean age of 36 years (SD=17.32) (2) a daily diary 3x per day for 30 days which examined affect, where alcohol was consumed and how much alcohol was consumed each day, at home and away from home negative mood items taken from the PANAS and mood circumplex using the DMQ (Cooper, 1994)

Mohr, Armeli, Tennen, Temple, Todd, Clark & Carney, 2005

Longitudinal (daily-diary)

If drinking motives moderate the relationship between social context and alcohol consumption

122 participants (56% women) with a Mean age of 19 years (SD = 1.16) Participants completed; (1) a baseline questionnaire of drinking motives and, (2) a daily diary 1x per day for 21 days which examined affect, social interactions, and alcohol consumption

Using the daily diary assessment, participants recorded the number of drinks they consumed each day, at home and away from home

The drinking context was examined by; (a) the number of hours participants spent with their friends; (b) positive and negative affect assessed using 16 items from the PANAS, and (c) daily social contact at school, work, social, and family.

All four drinking motives was assessed using the DMQ-R (Cooper, 1994)

Abbey, Smith, & Scott, 1993

Cross-sectional

The relationship between drinking motives and situational factors upon alcohol consumption

781 (55% women) participants with median age = 37 years Thirty-five-minute telephone interviews were conducted

Participants reported many days out of the past 30 they had consumed an alcoholic beverage

Participants were asked the following questions regarding the prior 30 days; (a) How often they consumed drinks containing alcohol when socializing with their friends.

Drinking to cope and drinking for social motives was assessed from Cahalan et al. (1969) Reasons to Drink Assessment

When coping motives were high as compared to low, individuals experiencing moderate or high levels of stress engaged in more heavy alcohol consumption. When social motives were high as compared to low, individuals...
<table>
<thead>
<tr>
<th>Authors</th>
<th>Study Design</th>
<th>Research Question</th>
<th>Methodology</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blevins, Abrantes, &amp; Stephens, 2018</td>
<td>Cross-sectional</td>
<td>The relationship between motives, situational factors and alcohol use</td>
<td>Participants completed an online survey that examined the key variables of the study.</td>
<td>The total number of drinks reported per week (in the prior month) was assessed by the Daily Drinking Questionnaire-Revised (Knuse et al. 2005). The situations of alcohol use was assessed using the Inventory of Drinking Situations (IDS-42; Annis et al. 1987). The following subscales were utilized: drinking in situations categorized by (a) unpleasant emotions, (b) pleasant emotions, (c) social pressure to drink, and (d) pleasant times with others. All four drinking motives were assessed by the Modified DMQ-R, (Grant et al. 2007)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(b) How frequently their friends drank alcohol when they were socializing together (c) The extent to which they felt stressed (i.e., did not have enough time, had too much work to do etc)</td>
<td></td>
<td>Drinking with unpleasant emotions was positively predicted by coping motives Drinking with pleasant emotions was positively predicted by social and enhancement and negatively by conformity Drinking with social pressure was positively predicted by social motives Drinking during pleasant times with others was positively predicted by social and enhancement motives</td>
</tr>
</tbody>
</table>

**Appendix 3.1**
Summary of the Studies Comprising the Systematic Review: Physical Location & Affect ($n=0$)

**Appendix 3.1**
Summary of the Studies Comprising the Systematic Review: Social Context, Physical Location & Affect ($n=0$)
CHAPTER FOUR: ECOLOGICAL MOMENTARY ASSESSMENT OF RSOD: A CONTEXTUALISED INVESTIGATION

Introduction

About a quarter of the young adult population in many Western countries (e.g., United States and Australia) consume alcohol in a risky manner (i.e., more than four standard alcoholic drinks in a single setting; Australian Institute of Health & Welfare, 2017; Center for Behavioral Health Statistics and Quality, 2017). Young adults who engage in risky drinking are more likely to experience unwanted sexual advances, injury, and violence (Grigsby, Forster, Unger, & Sussman, 2016). Identifying factors that differentiate risky from responsible drinking episodes in daily life is critical in order to develop better-targeted, timely, and effective treatment and prevention programs. As described in previous Chapters, the alcohol literature has been mostly concerned with examining how dispositional drinking motives predict episodes of risky drinking, among young people. Recent evidence however demonstrates that a combination of certain stable, trait-like characteristics (e.g., dispositional drinking motives) as well as momentary factors (e.g., momentary affect) can better help to identify who is most likely to drink excessively, and under what circumstance. Importantly, recent advances in smartphone technology has enabled scholars to develop a more sophisticated understanding of the interplay between these factors. The subsequent section briefly details these findings from the dispositional and situational examination into drinking behaviours.

Dispositional Influences on Alcohol Use

As described in Chapter Three, a number of cross-sectional studies have examined the interplay between dispositional drinking motives and state factors such as social,

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interpersonal factors or affect in predicting alcohol use or consequences. For example, individuals who endorse dispositional social, enhancement or conformity motives, report drinking more when they are in a social setting with other people as opposed to being on their own (e.g., Kuntsche, Otten, & Labhart, 2015; Smit, Groefsema, Luijten, Engels, & Kuntsche, 2015). Whereas, individuals who drink for dispositional coping motives, tend to report drinking more in a non-social context rather than a social context (e.g., Andersson et al., 2013; Blevins, Abrantes, & Stephens, 2018). In terms of affect, those who endorse coping motives report drinking excessively when they experience negative affect (e.g., Fitzgerald & Long, 2012) whereas those who endorse enhancement motives, report drinking a moderate amount when experiencing positive affect (e.g., Blevins, Abrantes, & Stephens, 2018). Finally, persons who drink for enhancement, social or conformity motives are shown to drink more when they are in a location that is away from home (Cooper 1994; O’Hara, Armeli, & Tennen, 2015), whereas persons who drink for coping motives tend to drink more when they are at home (Cooper; Mohr et al., 2001).

Although these findings suggest that an individual’s general tendency is towards one type of drinking motivation, other research findings using daily diary or Ecological Momentary Assessment (EMA) methods, suggest that individuals can endorse more than one drinking motive, both within and across drinking contexts, resulting in different drinking patterns (O’Hara et. al., 2014; 2015).

**Predicting Episodes of Alcohol Consumption**

Studies in which participants provide daily summaries of how much they drank that day and report their alcohol-related variables (daily diary approaches; e.g., O’Hara, Armeli, & Tennen, 2015) or reported their drinking experiences in the moment (EMA; e.g., Dvorak, Pearson, & Day, 2014) provide unique insights into how momentary
motives (i.e., drinking motives measured in the moment) and social context or affect influence young people’s drinking.

For example, the relationship between social context, momentary motives and alcohol use have been examined in two daily diary studies (O’Hara et. al., 2014; 2015) and have corroborated cross-sectional findings by demonstrating the endorsement of situational enhancement or social motives as predictive of increased alcohol use in social contexts. In contrast to cross-sectional findings however, coping motivation measured in the moment has been associated with increased alcohol use in a social rather than a non-social context (e.g., O’Hara et. al., 2015; Thrul, & Kuntsche, 2016). Studies of affect, momentary motives and alcohol use via daily diary and EMA methods, have been more consistent with the cross-sectional findings. Situation-specific enhancement has been shown to mediate the relationship between positive affect and alcohol use (Arbeau, Kuiken & Wild, 2011; Gautreau, Sherry, Battista, Goldstein, & Stewart, 2015) and situation-specific coping motives have been shown as related to increased alcohol consumption during daytime negative affect(e.g., Dvorak, Pearson, & Day, 2014; Ehrenberg, Armeli, Howland, & Tennen, 2016).

These findings highlight that the way in which young adults drink, and the associated consequences of drinking, depends in part on the relationship between the assessment of motives, affect and social contextual factors, in the moment. These relationships are missed when data is averaged across multiple drinking events, highlighting the importance of employing methods that examine fine-grained, momentary relationships between these key drinking determinants.

**Limitations of Prior Research**

The daily diary and EMA studies reviewed above are limited in at least two key respects. First, no study to date has tested how the key situational predictors (social context, physical location and affect) simultaneously measured together, predict
drinking behaviors. Without modelling the predictors simultaneously, the relative importance of each, and the extent to which these determinants interact, remains unknown. Second, previous studies have not distinguished between the binary decision to drink from the amount of alcohol consumed once drinking has commenced. This distinction is important, as the predictors of each may differ (as recent evidence suggests; Huh, Kaysen, & Atkins, 2015), and therefore allow interventions to target risk factors with greater precision. For example, certain interventions may be more effective for preventing the initiation of a drinking episode, which may be a more suitable approach in some situations or for some individuals (e.g., Carey, Scott-Sheldon, Carey, & DeMartini, 2007).

**Current Study**

The aim of the current study is to build on the current literature by examining how dispositional drinking motives and momentary factors predict distinct drinking outcomes; from the initial consumption of alcohol (No or Yes) to the amount of alcohol consumed once drinking has commenced (1, 2, 3…). Specifically, we investigated:

RQ1: To what extent do situational factors (i.e., affect, social contextual factors and drinking motives) and dispositional predictors (drinking motives) influence whether an individual chooses to drink or not, on a particular day?

RQ2: To what extent do situational factors (i.e., affect, social contextual factors and drinking motives) and dispositional predictors (drinking motives) influence the amount of alcohol an individual consumes within a drinking occasion?

**Method**

**Participants**

The sample comprised 83 (63 female, 20 male) young adults aged between 18 and 30 ($M_{age} = 21.42, SD_{age} = 3.09$) who had consumed alcohol at least once in the 4-week period prior to participation and had access to an iPhone mobile device (running
iOS 8.0+). Using the Alcohol Use Identification Test (AUDIT; Saunders, Aasland, Babor, & De La Fuente, 1993), on average, the sample exhibited a moderate level of drinking-related problems ($M = 9.88, SD = 4.80$) with scores ranging from 2 to 25. Scores greater than 15 indicate high-level drinking-related problems (n = 14, 16.87%; Babor, De La Fuente, Saunders, & Grant, 1989).

**Procedure**

Participants were recruited via invitations on social media (e.g., Facebook), and from advertisements placed within a large metropolitan university campus. Interested participants followed a weblink to a 30-minute baseline questionnaire containing demographic questions and the Drinking Motives Questionnaire-Revised (DMQ-R; Cooper, 1994). The baseline questionnaire provided instructions about how to download the ‘InstantSurvey’ smartphone application (app) used to administer the EMA component of the study (Richardson, 2015). During the EMA phase, the app delivered three audible alerts on participants’ phones per day at stratified random intervals between the times of 9:00 am to 8:00 pm, for 21 consecutive days. The minimum time interval between alerts was two hours. Following a prompt, participants were instructed to complete a one-minute self-report survey within 30 minutes. The Deakin University Ethics Committee approved this study, and all procedures were in accordance with the Australian Psychological Association guidelines for research (Australian Psychological Society, 2007)

**Materials**

**Baseline Survey**

Drinking motives were measured using the Drinking Motive Questionnaire Revised (DMQ-R; Cooper, 1994). Participants were asked to rate on a scale from 1 (almost never/never) to 5 (almost always/always) the extent to which they engaged in drinking for coping ($\alpha = .80$; e.g., “To forget your problems”); enhancement ($\alpha = .88$)
e.g., “For a pleasant feeling”); social (α = .89 e.g., “Improve parties and celebrations”); and conformity (α = .85, e.g., “To not feel left out”).

The Alcohol Use Dependence Identification Test (AUDIT; Saunders, Aasland, Babor, & De La Fuente, 1993) is a 10-item questionnaire that was used to investigate consumption, dependence, and drinking-related problems (α = 0.79). Items 1 to 8 are scored on a 5-point rating scale (0 = never, 5 = daily) and questions 9 to 10 are scored on a 3-point rating scale (0 = no, 2 = yes, in the past year). Research indicates that AUDIT scores from 8 to 15 represent a moderate level of risky drinking, with scores above 15 being representative of more problematic use, and scores greater than 20 indicative of probable alcohol dependence (Donovan, Kivlahan, Doyle, Longabaugh, & Greenfield, 2006).

**EMA Survey**

Alcohol use was examined at each time point by asking participants how many Standard alcoholic drinks (any drink containing 10 grams of alcohol) they had consumed since their last assessment, on a 7-point rating scale from 0 (none) to 6 (6 or more standard drinks).

Social context was examined through two items: first, at each time point participants were asked what their plans were for the evening. Response options included; “nightclub”, “public venue”, “staying home” and “other”. These items were dichotomised into either social plans (nightclub, public venue, other) or non-social plans (staying home) for the evening. Second, participants were asked if they were with others’ who were drinking and if so to indicate how much their companions had drunk on a 7-point rating scale from 0 (none) to 6 (6 or more standard drinks). At each time point, participants could only select one description of their social context.

Positive and negative affect were examined at each time point by asking participants to rate how they felt on four common affect states “Happy”, “Relaxed,
“Irritated” and “Stressed” on a 6-point rating scale (0 = not at all, 5 = very much so).

This was an adaption of the PANAS-SF (Thompson, 2007) to reduce response burden
and is consistent with the measurement of affect in previous EMA work (Kanning &
Schlicht, 2010).

Episode-specific drinking motives were examined at each time point with four
items (one item per motive) adapted from the DMQ-R (Cooper, 1994). These items
were in reference to the participants’ current motivation for alcohol use: coping;
(“drinking to cope with negative mood”), enhancement; (“to achieve a positive
feeling”), social (“to make a social gathering more fun”), and conformity (“to avoid
feeling left out”). These items were chosen as they exhibited the highest factor loadings
from the DMQ-R (Cooper, 1994). Participants responded on a 6-point rating scale (0 =
not at all, 5 = definitely).

Results

Data Analytic Strategy

A hurdle model (Huh, Kaysen, & Atkins, 2015) was used to explicitly
distinguish between a process which predicts a binary outcome, whether or not drinking
has occurred that day (‘alcohol episode’) and a process that explains the variability in a
continuous outcome, the number of drinks consumed on drinking days (‘alcohol
quantity’). Given these two processes have been identified as distinct (Huh, Kaysen, &
Atkins), employment of this analytic strategy enables us to directly test which predictors
are relevant for each of these behaviours.

As the EMA design employed in this study yields hierarchical data where
observations for specific days (Level 1) are nested within individuals (Level 2), a
multilevel hurdle model (Hox, 2010) was used. The drinking outcomes and the Level 1
predictors were aggregated to the day level. Aggregation to the day level was selected to
provide insight into the drinking behaviors as they unfolded across the days (rather than
time points). Moreover, with the large proportion of drinking occurring in the afternoon and evening (refer to Appendix 4.3) collation of these responses enabled a closer estimate of the average. Following the recommendation by Huh, Kaysen, and Atkins (2015), the multilevel hurdle model was estimated in two parts. First, multilevel logistic regression was used to model whether or not an individual consumed alcohol on a particular day (‘alcohol episode’). Second, a zero-truncated negative binomial model was used to predict the number of standard drinks consumed on days where the person was drinking (‘alcohol quantity’).

Consistent with the procedure described by Hox (2010), the models were constructed following a bottom-up approach using three steps. First, the Level 1 predictors were included in the model as fixed effects. Second, random effects were modeled in order to determine whether the strength of association between the Level 1 variables and the outcome differed across participants. Finally, Level 2 variables were entered into the model.

Level 1 continuous variables were person-mean centered within each set of analyses (i.e., level 1 predictors were person-mean centered within the logistic model and the count model, separately) thus the effects accurately represent differences in drinking behaviours based on deviations from each individual’s average scoring on the variables, relevant for that model. This reduces issues of multicollinearity (Curran & Bauer, 2011), aides interpretation of the Level 1 variability and facilitates the interpretation of interactions (Enders & Tofighi, 2007). Drinking motives included in Level 2 were grand-mean centered, within each set of analyses to improve the interpretation of the coefficients at Level 2 (Bauer & Curran, 2005). The analyses were performed using maximum likelihood estimation in R v3.1.3 (Team R, 2013) with the glmmADMB package (Skaug, Fournier, Nielsen, Magnusson, & Bolker, 2015).

EMA Compliance Statistics
In total, 83 participants responded to 2,247 prompts (out of 5,229 total prompts sent) across 1,061 days of self-monitoring. Of these, 180 were drinking days (17%). The average number of days participants responded to the EMA prompts was 12.77 days ($SD = 4.59$) out of a possible 21 days giving a compliance rate of 61%. When participants did engage with the app, the average number of prompts completed each day was 2.12 ($SD = 1.28$) out of a possible three. Preliminary analyses were conducted to evaluate whether the likelihood of missing EMA responses was related to individual difference variables (i.e., average alcohol consumption, age, or gender) or the day of the week. Missing EMA responses were unrelated to average alcohol consumption ($r = -.10, p = .32$), participant age ($r = .11, p = .32$), or gender ($r = -.01, p = .44$). EMA reporting was significantly more common during weekends than weekdays ($r = .33, p < .001$).

Time of assessment effects were explored by evaluating if increased frequency of reporting was identified across the testing period. A correlation between day order of assessment (day 1, day 2, etc.) and EMA reporting identified that EMA reporting was more likely on earlier days in testing period as opposed to later days ($r = -.48, p = .001$). Alcohol use reporting was also explored with respect to day of the week. Alcohol use was found to be more common during the weekend than on weekdays ($r = .14, p < .001$). As such, the main analyses controlled for the day of the week.

**Descriptive Statistics**

Table 1 presents the descriptive statistics of the key variables across both drinking and non-drinking days. Across all reporting days, the most frequent affective states reported were happy, relaxed, and stressed. Momentary drinking motivations emphasised enhancement and social motives somewhat more than coping and conforming motives. At the dispositional level, social motivation was the most common reason for drinking.
Table 1
Descriptive Data for Key Study Variables on All Days

<table>
<thead>
<tr>
<th>Level</th>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>Range</th>
<th>ICC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Momentary</td>
<td>Standard Drink</td>
<td>0.49</td>
<td>1.50</td>
<td>0 – 15</td>
<td>.09</td>
</tr>
<tr>
<td></td>
<td>Motive - Enhancement</td>
<td>0.84</td>
<td>1.26</td>
<td>0 – 5</td>
<td>.44</td>
</tr>
<tr>
<td></td>
<td>Motive - Social</td>
<td>0.82</td>
<td>1.31</td>
<td>0 – 5</td>
<td>.19</td>
</tr>
<tr>
<td></td>
<td>Motive - Cope</td>
<td>0.68</td>
<td>1.13</td>
<td>0 – 5</td>
<td>.55</td>
</tr>
<tr>
<td></td>
<td>Motive - Conform</td>
<td>0.47</td>
<td>0.93</td>
<td>0 – 5</td>
<td>.17</td>
</tr>
<tr>
<td></td>
<td>Affect - Happy</td>
<td>2.93</td>
<td>1.05</td>
<td>0 – 5</td>
<td>.29</td>
</tr>
<tr>
<td></td>
<td>Affect - Relax</td>
<td>2.72</td>
<td>1.19</td>
<td>0 – 5</td>
<td>.31</td>
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<tr>
<td></td>
<td>Affect - Stress</td>
<td>2.08</td>
<td>1.46</td>
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<td>.40</td>
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<tr>
<td></td>
<td>Affect - Irritated</td>
<td>1.36</td>
<td>1.27</td>
<td>0 – 5</td>
<td>.30</td>
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<td>Evening Plans</td>
<td>0.40</td>
<td>0.47</td>
<td>0 – 1</td>
<td>.25</td>
</tr>
<tr>
<td></td>
<td>Others’ Alcohol Use</td>
<td>0.22</td>
<td>0.82</td>
<td>0 – 6</td>
<td>.00</td>
</tr>
</tbody>
</table>

Dispositional

| Motive - Enhancement | 14.80 | 5.01 | 5 – 25 |
| Motive - Social     | 18.03 | 5.11 | 5 – 25 |
| Motive - Cope       | 10.84 | 4.43 | 5 – 25 |
| Motive - Conform    | 8.82  | 4.19 | 5 – 24 |

Note. ICC = intraclass coefficients. Standard Drink is defined as consumption of an alcoholic beverage with 10 grams of alcohol. As the data are aggregated at the level of the day, the maximum range of alcohol intake was 15. Evening plans were coded as 0 = non-social, 1 = social. Others’ Alcohol Use refers to the individual being around others who were drinking.

Table 2 presents the relevant descriptive statistics for drinking days only. Results show that when participants did drink, they were on average consuming 2.86 standard drinks and were more likely to describe their affect as happy and relaxed. The most common motivations reported during drinking episodes was social and enhancement motivation.

Table 2
Descriptive Data for Key Study Variables on Drink Days

<table>
<thead>
<tr>
<th>Level</th>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>Range</th>
<th>ICC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Momentary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The bivariate correlations are presented in Table 3. Results showed number of standard drinks and alcohol use (yes/no) was significantly, positively correlated with a number of momentary factors; the four momentary drinking motives, relaxed and happy affect, social plans and being with others who were drinking. At the dispositional level, conformity motivation was positively associated with both drinking outcomes.
<table>
<thead>
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<td>2.72**</td>
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<td>.24**</td>
<td>.08*</td>
<td>.21**</td>
<td>.18**</td>
<td>.17**</td>
<td>.28**</td>
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<td>.02</td>
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<td>4.58**</td>
<td>.16**</td>
<td>.18**</td>
<td>.10**</td>
<td>.50**</td>
<td>.69**</td>
<td>.33**</td>
<td>.50**</td>
<td>.43**</td>
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<td>.23**</td>
<td>.16**</td>
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<td>6.62**</td>
<td>.71**</td>
<td>.62**</td>
<td>.71**</td>
<td>.69**</td>
<td>.33**</td>
<td>.50**</td>
<td>.50**</td>
<td>.12**</td>
<td>.15**</td>
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<td>.14**</td>
<td>.14**</td>
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<td>.08**</td>
<td>.08**</td>
<td>.08**</td>
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<td>.06**</td>
<td>.07**</td>
<td>-.03</td>
<td>.04</td>
<td>.04</td>
<td>.06</td>
<td>.11**</td>
<td>-.05</td>
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<td>15.62**</td>
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<td>.04**</td>
<td>.04**</td>
<td>.04**</td>
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</tbody>
</table>

**Note:** Standard Drink is defined as an alcoholic beverage with 10 grams of alcohol per drink. Drink Yes/No is coded as 0 = no drinking that day, 1 = drinking that day. Evening plans are coded as 0 = non-social, 1 = social. Others’ Alcohol Use refers to the individual being around others who were drinking. To control for the multiple correlations undertaken a more stringent alpha rate of .01 was adhered to.

* p < .05
** p < .01
**Hurdle Model a: Predicting Alcohol Consumption (Yes/No)**

The likelihood that an individual would consume alcohol was related to whether others were drinking (OR = 9.83; see Table 4), drinking for enhancement motivation, at the momentary level (OR = 1.45). At the dispositional level, being motivated to drink for conformity motives was positively associated with alcohol consumption (OR = 1.17).

**Table 4**
Multilevel Logistic Regression Predicting Alcohol Consumption From Momentary Predictors; Drinking Motives, Affect and Social Context, and Dispositional Predictors; Drinking Motives

<table>
<thead>
<tr>
<th>Momentary</th>
<th>B</th>
<th>p</th>
<th>95% CI</th>
<th>Odds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-2.41**</td>
<td>&lt;.001</td>
<td>-2.87 – -1.95</td>
<td>0.09</td>
</tr>
<tr>
<td>Weekend</td>
<td>0.03</td>
<td>.89</td>
<td>-0.43 – 0.50</td>
<td>1.03</td>
</tr>
<tr>
<td>Evening Plans</td>
<td>0.28</td>
<td>.32</td>
<td>-0.27 – 0.83</td>
<td>1.32</td>
</tr>
<tr>
<td>Others’ Alcohol Use</td>
<td>2.29**</td>
<td>&lt;.001</td>
<td>1.72 – 2.85</td>
<td>9.83</td>
</tr>
<tr>
<td>Motive - Enhance</td>
<td>0.37*</td>
<td>.02</td>
<td>0.05 – 0.69</td>
<td>1.45</td>
</tr>
<tr>
<td>Motive - Social</td>
<td>-0.15</td>
<td>.32</td>
<td>-0.45 – 0.15</td>
<td>0.86</td>
</tr>
<tr>
<td>Motive - Cope</td>
<td>0.15</td>
<td>.45</td>
<td>-0.23 – 0.53</td>
<td>1.17</td>
</tr>
<tr>
<td>Motive - Conform</td>
<td>0.01</td>
<td>.98</td>
<td>-0.36 – 0.37</td>
<td>1.01</td>
</tr>
<tr>
<td>Affect - Happy</td>
<td>0.31</td>
<td>.09</td>
<td>-0.05 – 0.68</td>
<td>1.37</td>
</tr>
<tr>
<td>Affect - Relaxed</td>
<td>-0.05</td>
<td>.76</td>
<td>-0.35 – 0.26</td>
<td>0.95</td>
</tr>
<tr>
<td>Affect - Stressed</td>
<td>-0.07</td>
<td>.60</td>
<td>-0.35 – 0.20</td>
<td>0.93</td>
</tr>
<tr>
<td>Affect - Irritated</td>
<td>0.05</td>
<td>.74</td>
<td>-0.25 – 0.35</td>
<td>1.05</td>
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</table>

<table>
<thead>
<tr>
<th>Dispositional</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Motive - Enhance</td>
<td>-0.02</td>
<td>.58</td>
<td>-0.07 – 0.03</td>
<td>0.98</td>
</tr>
<tr>
<td>Motive - Social</td>
<td>-0.05</td>
<td>.31</td>
<td>-0.12 – 0.02</td>
<td>0.95</td>
</tr>
<tr>
<td>Motive - Cope</td>
<td>0.07</td>
<td>.19</td>
<td>-0.04 – 0.10</td>
<td>1.07</td>
</tr>
<tr>
<td>Motive - Conform</td>
<td>0.15**</td>
<td>&lt;.01</td>
<td>0.09 – 0.21</td>
<td>1.17</td>
</tr>
</tbody>
</table>

*Note.* Outcome is coded as 0 = no drinking that day, 1 = drinking that day. Evening plans are coded as 0 = non-social, 1 = social. Others’ Alcohol Use refers to the individual being around others who were consuming alcohol.

*p <.05. **p <.01.

**Hurdle Model b: Predicting the Quantity of Alcohol Consumed (1,2, 3... drinks)**

At the momentary level, a positive predictor of the quantity of alcohol consumed was being surrounded by others’ who were drinking (B = 0.23; See Table 5) and social evening plans (B = 0.32). At the dispositional level, drinking to conform was positively related to alcohol quantity (B = 0.03).
Table 5
Multilevel Zero-Truncated Regression Predicting Alcohol Quantity From Momentary Predictors; Drinking Motives, Affect and Social Context, and Dispositional Predictors; Drinking Motives

<table>
<thead>
<tr>
<th>Momentary</th>
<th>B</th>
<th>SE</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-0.00</td>
<td>.17</td>
<td>.98</td>
</tr>
<tr>
<td>Weekend</td>
<td>0.07</td>
<td>.14</td>
<td>.65</td>
</tr>
<tr>
<td>Evening Plans</td>
<td>0.32*</td>
<td>.15</td>
<td>.04</td>
</tr>
<tr>
<td>Others’ Alcohol Use</td>
<td>0.23**</td>
<td>.03</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Motive - Enhance</td>
<td>0.17</td>
<td>.09</td>
<td>.06</td>
</tr>
<tr>
<td>Motive - Social</td>
<td>-0.03</td>
<td>.08</td>
<td>.68</td>
</tr>
<tr>
<td>Motive - Cope</td>
<td>-0.19</td>
<td>.11</td>
<td>.08</td>
</tr>
<tr>
<td>Motive - Conform</td>
<td>-0.11</td>
<td>.08</td>
<td>.17</td>
</tr>
<tr>
<td>Affect - Happy</td>
<td>-0.14</td>
<td>.11</td>
<td>.20</td>
</tr>
<tr>
<td>Affect - Relaxed</td>
<td>0.05</td>
<td>.08</td>
<td>.56</td>
</tr>
<tr>
<td>Affect - Stressed</td>
<td>-0.06</td>
<td>.08</td>
<td>.45</td>
</tr>
<tr>
<td>Affect - Irritated</td>
<td>0.00</td>
<td>.09</td>
<td>.97</td>
</tr>
<tr>
<td>Dispositional</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Motive - Enhance</td>
<td>0.01</td>
<td>.01</td>
<td>.71</td>
</tr>
<tr>
<td>Motive - Social</td>
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<td>.02</td>
<td>.60</td>
</tr>
<tr>
<td>Motive - Cope</td>
<td>0.02</td>
<td>.02</td>
<td>.26</td>
</tr>
<tr>
<td>Motive - Conform</td>
<td>0.03*</td>
<td>.01</td>
<td>.03</td>
</tr>
</tbody>
</table>

Note. Outcome is coded as the number of Standard alcoholic beverages (10 grams of alcohol per drink) consumed on a drinking day. Evening plans are coded as (0 = non-social, 1 = social). Others’ Alcohol Use refers to the individual being around others who were drinking. *p <.05. **p <.01

Discussion

This is the first study to examine to what extent dispositional drinking motives and features of the drinking situation predict the initiation of alcohol consumption and/or the quantity of alcohol consumed. Interestingly, the findings identified social factors and drinking motives as primary determinants in the prediction of drinking behaviors with affect playing less of a role than expected.

Main Findings

The main finding that emerged from this study was that the social context was the strongest predictor of both alcohol initiation, and consumption. Specifically, being surrounded by others who were drinking increased the likelihood that the individual would drink, by more than nine times, in comparison to contexts in which the individual was not surrounded by other people drinking. This finding is consistent with prior observational studies showing young people drink in a manner that matches how their
own social group is drinking (Borsari, Murphy, & Barnett, 2007; Thrul & Kuntsche, 2016). However, this study extends these findings by demonstrating the social context as related to both, the initial decision to use alcohol, and the decision to continue drinking. With the substantial amount of variance that social context explained in both forms of drinking behavior, it appeared negative and positive affect were not significantly related to either drinking outcome, despite prior evidence that suggests affect is one of the strongest predictors of young adult’s drinking (Armeli et al. 2014; Goldsmith, Tran, Smith, & Howe, 2009). Taken together, this EMA study provides important evidence that young people’s drinking behavior is most strongly influenced by the nature of the social context, more so than their internal affective state.

The second important finding is that momentary enhancement motivation was positively predictive of alcohol initiation but not continued alcohol consumption. This suggests that those who are motivated to drink, in order to enhance their positive affect, will be more likely to initiate alcohol use, but not necessarily more likely to engage in continued drinking. Interestingly, this contrasts with cross-sectional studies that have found dispositional enhancement motives as predictive of heavy drinking patterns (Kuntsche, Knibbe, Gmel, & Engels, 2006; Müller & Kuntsche, 2011) and daily diary studies (O’Hara et. al., 2014; 2015) which found momentary enhancement motivation as predictive of risky drinking. It appears that when enhancement motives are measured in the moment, and alcohol use is separated into ‘initiation of use’ and ‘continued use’, some interesting differences are revealed. This may suggest that enhancing one’s affect is achieved by the act of initiating alcohol use (e.g., due to celebratory toast or the flavor of alcohol) but not necessarily related to continued alcohol use, as this could interfere with the enhancement of one’s affect through the experience of adverse consequences (e.g., feeling sick or acting inappropriately). Further research is required to confirm the role that momentary enhancement motives play in the prediction of different forms of
drinking behavior.

Finally, dispositional conformity drinking motivation was the only trait-level factor predictive of drinking behaviors; those who were motivated to drink as a way to conform with others, initiated more drinking episodes and consumed a higher quantity of alcohol compared to those who drank for different dispositional motivations. This is an interesting finding given prior research tends to find dispositional conformity motives, as either unrelated to alcohol use (Gonzalez, Collins, & Bradizza, 2009; Smit, Groefsema, Luijten, Engels, & Kuntsche, 2015) or negatively related to alcohol use (Cooper, 1994; Kuntsche et al., 2014). It has been suggested that the effects of conformity motives depend on the type of social context the individual is in and the drinking norms exhibited (Kuendig & Kuntsche, 2013). Given the current sample commonly reported being surrounded by other people who were drinking, it is possible that those who were also motivated to conform were at a higher likelihood of engaging in drinking behaviors as they adapted their drinking behaviours to match the norms present in the social context.

Limitations and Future Research Directions

A number of limitations warrant consideration. Compliance to the app was moderate at about 60% with a clear trend of higher engagement earlier in the EMA phase. Although Fuller-Tyszkiewicz and colleagues (2013) demonstrate that a moderate compliance rate is not necessarily indicative of poorer quality data, the current findings which follow this trend of less engagement over time, suggest that there may have been inherent issues in the design of the app (e.g., the study duration of 21 days, with three daily alerts could be burdensome). Further research is essential to identify what the best methods are to obtain a high level of quality engagement from participants in EMA studies.
A further limitation of this study was our brief measure of social context which only included two items; the young person’s plans for the evening and if they were with other people who were drinking. This measure failed to capture the specific composition of who the person was with (e.g., demographics, relationship) and the precise drinking behavior of the group (e.g., low or high alcohol consumption). Future studies should examine the specific composition of the interpersonal context and how this influences an individual’s alcohol consumption.

**Implications**

Drinking-based interventions for young people tend to focus on increasing motivation to change (e.g., Vasilaki, Hosier, & Cox, 2006), or reducing negative affect using cognitive-behavior therapy (e.g., Carey, Scott-Sheldon, Carey, & DeMartini, 2007). However, these findings indicate that it is the peer group surrounding the young person which is the primary factor in determining their decision to drink, and how much. An Ecological Momentary Intervention (EMI) that delivers harm minimisation strategies during peer drinking situations is a potential way forward in reducing risky drinking in young people. This design is advantageous as the delivery of the intervention is close in time to the high-risk trigger (peer drinking group) which research identifies as highly effective in changing behaviours (e.g., Johnson, Jackson, Guillaume, Meier, & Goyder, 2010).

**Conclusion**

This study is the first of its kind to examine the role that key momentary determinants have in the prediction of distinct drinking behaviours. Interestingly, compared to cross-sectional and daily diary studies, this study highlights that the key determinant underpinning a young person’s decision to drink and how much they drink, is the interpersonal context they are exposed to. An examination that tests the extent to which conformity dispositional drinking motives moderates the relationship between
the interpersonal context and initiation of alcohol use and continued consumption, would be an important addition to this important field of work. Moreover, it would be helpful to examine if there is a lagged effect of affect upon drinking behaviors, as other studies suggest (e.g., Dvorak, Pearson, & Day, 2014).

Informed by these findings, the next Chapter details the development and evaluation of a drinking-reduction EMI smartphone app that uses innovative technology to deliver harm-minimisation strategies tailored to the user and their drinking situation, in real time. It is anticipated that this intervention will effectively reduce alcohol-consumption and subsequent harms as the current findings from this Chapter suggest that intervening on situational factors, particularly social in nature, could mitigate both the initiation of alcohol use, and continued alcohol consumption.
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## Appendix 4.1

Ethics Approval for Empirical Study One

### Memo

| To:       | Dr Ben Richardson  
| School of Psychology |
| From:    | Secretary – HEAG-H  
| Faculty of Health |
| CC:      | Miss Renee O’Donnell, A/Prof Petra Staiger, Dr Matthew Fuller-Tyszkiewicz |
| Date:    | 26 March, 2015 |
| Re:      | HEAG-H 18-2015: What is the context surrounding alcohol consumption |

Approval has been given for Dr Ben Richardson, of the School of Psychology, to undertake this project for a period of 1 year from 26 March, 2015. The current end date for this project is 26 March, 2016.

The approval given by the Deakin University HEAG-H is given only for the project and for the period as stated in the approval. It is your responsibility to contact the Secretary immediately should any of the following occur:

- Serious or unexpected adverse effects on the participants
- Any proposed changes in the protocol, including extensions of time
- Any events which might affect the continuing ethical acceptability of the project
- The project is discontinued before the expected date of completion
- Modifications that have been requested by other Human Research Ethics Committees

In addition you will be required to report on the progress of your project at least once every year and at the conclusion of the project. Failure to report as required will result in suspension of your approval to proceed with the project.

An Annual Project Report Form can be found at:


This should be completed and returned to the Administrative Officer to the HEAG-H, Pro-Vice Chancellor’s office, Faculty of Health, Burwood campus by Tuesday 17th November, 2015 and when the project is completed. HEAG-H may need to audit this project as part of the requirements for monitoring set out in the National Statement on Ethical Conduct in Human Research (2007).

Good luck with the project!
Appendix 4.2

Manuscript Submitted to Addictive Behaviors

Abstract

Introduction: Daily assessment studies have examined how momentary factors, such as affect, social context, and drinking motives, alongside dispositional drinking motives, predict young adults’ risky drinking. However, these studies did not examine how the interplay between drinking motives (dispositional and momentary) and multiple features of the drinking situation predict risky drinking with respect to either the initial decision to drink or the quantity of alcohol consumed. Ecological momentary assessment (EMA) via smartphone technology, enables us to address this gap by evaluating to what extent dispositional drinking motives and momentary factors predict: a) the initiation of drinking episodes and; b) the quantity of alcohol consumed.

Methods: Participants were 83 young adults (63 female) aged 18 to 30 ($M = 21.42, SD = 3.09$) who participated in an EMA study for 21 days via their smartphone. On a daily basis, participants received three random-interval prompts that measured momentary affect, drinking motives, social context, and alcohol use.

Results: A multilevel hurdle analysis found that young adults were more likely to both initiate a drinking episode and consume a higher quantity of alcohol if they were surrounded by other people who were drinking and were motivated to drink to conform to the reference group.

Conclusions: This study is the first of its kind to demonstrate that distinct drinking behaviors are predicted by a similar set of predictors. Drinking-based interventions that address these risk factors could effectively reduce risky drinking as it would intervene on both the decision to initiate alcohol use, and the decision to continue drinking.

Keywords: Alcohol; Young Adults; Drinking Motives; Contextual Factors; Ecological Momentary Assessment

1. Introduction
About a quarter of the young adult population in most Western countries consume alcohol in a risky manner (i.e., more than four standard alcoholic drinks in a single setting [e.g., Australian Institute of Health & Welfare, 2017]). Young adults who engage in risky drinking are more likely to experience unwanted sexual advances, injury, and violence (Grigsby, Forster, Unger, & Sussman, 2016). Identifying factors that differentiate risky from responsible drinking episodes in daily life is critical in order to develop better-targeted, timely, and effective prevention programs. Understanding how the interplay between relevant stable, trait-like characteristics (e.g., dispositional drinking motives) as well as momentary factors (e.g., daily affect, social contextual factors, and drinking motivations) can help identify who is most likely to engage in risky drinking, and when. This study utilizes recent advances in smartphone technology in order to progress towards a more sophisticated understanding of the interplay between these factors.

1.1. Dispositional Influences on Alcohol Use

Over the last two decades, hundreds of cross-sectional studies have investigated the role of drinking motivations in determining risky drinking behaviors among young adults. The primary model of drinking motives has been Cooper’s Four Factor Motivational Model (1994) which conceptualises drinking motives according to four factors: (i) enhancement - drinking to enhance positive affect; (ii) social - drinking to obtain social rewards; (iii) coping - drinking to reduce negative affect; and (iv) conformity - drinking to avoid social rejection. To briefly summarise the literature, young adults appear to be motivated to drink primarily for social or enhancement motives (Kilwein & Looby, 2018; Kuntsche & Müller, 2012). Of these two motives, enhancement is most consistently associated with alcohol consumption patterns such as risky drinking (Kuntsche, Knibbe, Gmel, & Engels, 2006; Merrill & Read, 2010). For the smaller proportion of young people who report a tendency to drink for coping or
conformity motives, these motives have been primarily associated with adverse drinking-related consequences, such as drink-driving and interpersonal conflict (Kuntsche, Knibbe, Gmel, & Engels, 2005; Merrill, Wardell, & Read, 2014).

1.2. Cross-Sectional Investigation of Dispositional Motives and State Factors on Alcohol Use

A number of cross-sectional studies have examined the interplay between dispositional drinking motives and state factors such as social, interpersonal factors or affect in predicting alcohol use or consequences. For example, individuals who endorse dispositional social, enhancement or conformity motives, report drinking more when they are in a social setting with other people as opposed to being on their own (e.g., Kuntsche, Otten, & Labhart, 2015; Smit, Groefsema, Luijten, Engels, & Kuntsche, 2015). Whereas, individuals who drink for dispositional coping motives, tend to report drinking more in a non-social context rather than a social context (e.g., Andersson et al., 2013; Blevins, Abrantes, & Stephens, 2018). In terms of affect, those who endorse coping motives report drinking excessively when they experience negative affect (e.g., Fitzgerald & Long, 2012) whereas those who endorse enhancement motives, report drinking a moderate amount when experiencing positive affect (e.g., Blevins, Abrantes, & Stephens, 2018).

Although these findings suggest that an individual’s general tendency is towards one type of drinking motivation, as opposed to another, and this motivation is related to distinct drinking-related patterns under certain circumstances, other research findings using daily diary or Ecological Momentary Assessment (EMA) methods, suggest that individuals can endorse more than one drinking motive, both within and across drinking contexts, resulting in different drinking patterns (O’Hara et. al., 2014; 2015).

1.3. Prospective Studies Examining State and Dispositional Influences on Alcohol Use
Studies in which participants provide daily summaries of how much they drank that day (daily diary approaches; e.g., O’Hara, Armeli, & Tennen, 2015) or reported their drinking experiences in the moment (EMA; e.g., Dvorak, Pearson, & Day, 2014) provide unique insights into how momentary motives (i.e., drinking motives measured in the moment) and social context or affect influence young people’s drinking.

For example, the relationship between social context, momentary motives and alcohol use have been examined in two daily diary studies (O’Hara et. al., 2014; 2015) and have corroborated cross-sectional findings by demonstrating the endorsement of momentary enhancement or social motives as predictive of increased alcohol use in social contexts. In contrast to cross-sectional findings however, coping motivation measured in the moment has been associated with increased alcohol use in a social rather than a non-social context (e.g., O’Hara et. al., 2015; Thrul, & Kuntsche, 2016). Furthermore, studies of affect, momentary motives and alcohol use via daily diary and EMA methods, have been both consistent (enhancement motives) and discrepant (coping motives) with the cross-sectional findings. Consistent with cross-sectional findings, momentary enhancement has been shown to mediate the relationship between positive affect and alcohol use (Arbeau, Kuiken & Wild, 2011; Gautreau, Sherry, Battista, Goldstein, & Stewart, 2015). In terms of momentary coping motives, some studies are consistent with cross-sectional findings identifying momentary coping motives were related to increased alcohol consumption during times of negative affect (e.g., Dvorak, Pearson, & Day, 2014; Ehrenberg, Armeli, Howland, & Tennen, 2016), while other studies counter this and show those who endorse momentary coping motives as less likely to drink when negative affect is experienced (Hussong, Galloway, & Feagans, 2005; Mohr et al., 2013).

The number of unique findings that emerge within the daily-diary and EMA literature, provides clear evidence that the way in which young adults drink, and the
associated consequences of drinking, depends in part on the relationship between the
assessment of motives, affect and social contextual factors, in the moment. These
relationships are missed when data is averaged across multiple drinking events,
highlighting the importance of employing methods that examine fine-grained,
mommentary relationships between these key drinking determinants.

1.4. Limitations of Prior Research

The daily diary and EMA studies reviewed above are limited in at least two key
respects. First, no study to date has tested how the key momentary predictors (social context and affect) simultaneously measured together, predict drinking behaviors.
Second, previous studies have not distinguished between the binary decision to drink from the amount of alcohol consumed once drinking has commenced. This distinction is important, as the predictors of each may differ (as recent evidence suggests; Huh, Kaysen, & Atkins, 2015), and therefore allow interventions to target risk factors with greater precision. For example, certain interventions may be more effective for preventing the initiation of a drinking episode, which may be a more suitable approach in some situations or for some individuals (e.g., Carey, Scott-Sheldon, Carey, & DeMartini, 2007).

1.5. Current Study

The aim of the current study is to build on the current literature by examining how dispositional drinking motives and momentary factors predict distinct drinking outcomes; from the initial consumption of alcohol (No or Yes) to the amount of alcohol consumed once drinking has commenced (1, 2, 3…). Specifically, we investigated:

RQ1: To what extent do momentary factors (i.e., affect, social contextual factors and drinking motives) and dispositional predictors (drinking motives) influence whether an individual chooses to drink or not, on a particular day?
RQ2: To what extent do momentary factors (i.e., affect, social contextual factors and drinking motives) and dispositional predictors (drinking motives) influence the amount of alcohol an individual consumes within a drinking occasion?

2. Methods

2.1. Participants

The sample comprised 83 (63 female, 20 male) young adults aged between 18 and 30 (M = 21.42, SD = 3.09) who had consumed alcohol at least once in the 4-week period prior to participation and had access to an iPhone mobile device (running iOS 8.0+). Using the Alcohol Use Identification Test (AUDIT; Saunders, Aasland, Babor, & De La Fuente, 1993), on average, the sample exhibited a moderate level of drinking-related problems (M = 9.88, SD = 4.80) with scores ranging from 2 to 25. Scores greater than 15 indicate high-level drinking-related problems (n = 14, 16.87%; Babor, De La Fuente, Saunders, & Grant, 1989).

2.2. Procedure

Participants were recruited via invitations on social media and advertisements placed within a university campus. Participants followed a weblink to a 30-minute baseline questionnaire. Upon completion, they downloaded the ‘Instant Survey’ smartphone application (app). During the EMA phase, the app delivered three audible alerts per day at stratified random intervals between 9:00 am to 8:00 pm, for 21 consecutive days. The minimum time interval between alerts was two hours. Following a prompt, participants were instructed to complete a one-minute self-report survey within 30 minutes.

2.3. Materials

2.3.1. Baseline Survey
Drinking motives were measured using the Drinking Motive Questionnaire Revised (DMQ-R; Cooper, 1994). Participants were asked to rate on a scale from 1 (almost never/never) to 5 (almost always/always) the extent to which they engaged in drinking for coping (α = .80; e.g., “To forget your problems”); enhancement (α = .88 e.g., “For a pleasant feeling”); social (α = .89 e.g., “Improve parties and celebrations”); and conformity (α = .85, e.g., “To not feel left out”).

The AUDIT (Saunders, Aasland, Babor, & De La Fuente, 1993) is a 10-item questionnaire that was used to investigate consumption, dependence, and drinking-related problems (α = 0.79). Items 1 to 8 are scored on a 5-point rating scale (0 = never, 5 = daily) and questions 9 to 10 are scored on a 3-point rating scale (0 = no, 2 = yes, in the past year).

2.3.2. EMA Survey

Alcohol use was examined at each time point by asking participants how many standard alcoholic drinks (any drink containing 10 grams of alcohol) they had consumed since their last assessment, on a 7-point rating scale from 0 (none) to 6 (6 or more standard drinks).

Social context was examined through two items: first, at each time point participants were asked what their plans were for the evening. Response options included; “nightclub”, “public venue”, “staying home” and “other”. These items were dichotomised into either social plans (nightclub, public venue, other) or non-social plans (staying home) for the evening. Second, participants were asked if they were with others’ who were drinking and if so to indicate how much their companions had drunk on a 7-point rating scale from 0 (none) to 6 (6 or more standard drinks).

Positive and negative affect were examined at each time point by asking participants to rate how they felt on four common affect states “Happy”, “Relaxed”, “Irritated” and “Stressed” on a 6-point rating scale (0 = not at all, 5 = very much so).
This was an adaptation of the PANAS-SF (Thompson, 2007) to reduce response burden and is consistent with the measurement of affect in previous EMA work (Kanning & Schlicht, 2010).

Episode-specific drinking motives were examined at each time point with four items (one item per motive) adapted from the DMQ-R (Cooper, 1994). These items were in reference to the participants’ current motivation for alcohol use: coping (“to cope with negative mood”), enhancement; (“to achieve a positive feeling”), social (“to make a social gathering more fun”), and conformity (“to avoid feeling left out”). These items were chosen as they exhibited the highest factor loadings from the DMQ-R (Cooper). Participants responded on a 6-point rating scale (0 = not at all, 5 = definitely).

3. Results

3.1 Data Analytic Strategy

A hurdle model (Huh, Kaysen, & Atkins, 2015) was used to explicitly distinguish between a process which predicts a binary outcome, whether or not drinking has occurred that day (‘alcohol episode’) and a process that explains the variability in a continuous outcome, the number of drinks consumed on drinking days (‘alcohol quantity’). Given these two processes have been identified as distinct (Huh, Kaysen, & Atkins), employment of this analytic strategy enables us to directly test which predictors are relevant for each of these behaviors.

As the EMA design employed in this study yields hierarchical data where observations for specific days (Level 1) are nested within individuals (Level 2), a multilevel hurdle model (Hox, 2010) was used. The drinking outcomes and the Level 1 predictors were aggregated to the day level. Following the recommendation by Huh, Kaysen, and Atkins (2015), the multilevel hurdle model was estimated in two parts. First, multilevel logistic regression was used to model whether or not an individual consumed alcohol on a particular day (‘alcohol episode’). Second, a zero-truncated
negative binomial model was used to predict the number of standard drinks consumed on days where the person was drinking (‘alcohol quantity’).

Consistent with the procedure described by Hox (2010), the models were constructed following a bottom-up approach using three steps. First, the Level 1 predictors were included in the model as fixed effects. Second, random effects were modeled in order to determine whether the strength of association between the Level 1 variables and the outcome differed across participants. Finally, Level 2 variables were entered into the model.

Level 1 continuous variables were person-mean centered within each set of analyses (i.e., level 1 predictors were person-mean centered within the logistic model and the count model, separately) thus the effects accurately represent differences in drinking behaviors based on deviations from each individual’s average scoring on the variables, relevant for that model. This reduces issues of multicollinearity (Curran & Bauer, 2011), aides interpretation of the Level 1 variability and facilitates the interpretation of interactions (Enders & Tofighi, 2007). Drinking motives included in Level 2 were grand-mean centered, within each set of analyses to improve the interpretation of the coefficients at Level 2 (Bauer & Curran, 2005). The analyses were performed using maximum likelihood estimation in R v3.1.3 (Team R, 2013) with the glmmADMB package (Skaug, Fournier, Nielsen, Magnusson, & Bolker, 2015).

3.2 EMA Compliance Statistics

In total, 83 participants responded to 2,247 prompts (out of 5,229 total prompts sent) across 1,061 days of self-monitoring. Of these, 180 were drinking days (17%). The average number of days participants responded to the EMA prompts was 12.77 days ($SD = 4.59$) out of a possible 21 days giving a compliance rate of 61%. When participants did engage with the app, the average number of prompts completed each day was 2.12 ($SD = 1.28$) out of a possible three. Preliminary analyses were conducted
to evaluate whether the likelihood of missing EMA responses was related to individual difference variables (i.e., average alcohol consumption, age, or gender) or the day of the week. Missing EMA responses were unrelated to average alcohol consumption ($r = -.10, p = .32$), participant age ($r = .11, p = .32$), or gender ($r = -.01, p = .44$). EMA reporting was significantly more common during weekends than weekdays ($r = .33, p < .001$).

Time of assessment effects were explored by evaluating if increased frequency of reporting was identified across the testing period. A correlation between day order of assessment (day 1, day 2, etc.) and EMA reporting identified that EMA reporting was more likely on earlier days in testing period as opposed to later days ($r = -.48, p = <.001$). Alcohol use reporting was also explored with respect to day of the week. Alcohol use was found to be more common during the weekend than on weekdays ($r = .14, p<.001$). As such, the main analyses controlled for the day of the week.

### 3.3. Descriptive Statistics

Table 1 presents the descriptive statistics of the key variables across both drinking and non-drinking days. Across all reporting days, the most frequent affective states reported were happy, relaxed, and stressed. Momentary drinking motivations emphasized enhancement and social motives somewhat more than coping and conforming motives. At the dispositional level, social motivation was the most common reason for drinking.

**Table 1**

*Descriptive Data for Key Study Variables on All Days*

<table>
<thead>
<tr>
<th>Level</th>
<th>Variable</th>
<th>$M$</th>
<th>$SD$</th>
<th>Range</th>
<th>$ICC$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Momentary</td>
<td>Standard Drink</td>
<td>0.49</td>
<td>1.50</td>
<td>0 – 15</td>
<td>.09</td>
</tr>
<tr>
<td></td>
<td>Motive – Enhancement</td>
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<td>0 – 5</td>
<td>.44</td>
</tr>
<tr>
<td></td>
<td>Motive – Social</td>
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<td>1.31</td>
<td>0 – 5</td>
<td>.19</td>
</tr>
<tr>
<td></td>
<td>Motive – Cope</td>
<td>0.68</td>
<td>1.13</td>
<td>0 – 5</td>
<td>.55</td>
</tr>
<tr>
<td></td>
<td>Motive – Conform</td>
<td>0.47</td>
<td>0.93</td>
<td>0 – 5</td>
<td>.17</td>
</tr>
<tr>
<td></td>
<td>Affect – Happy</td>
<td>2.93</td>
<td>1.05</td>
<td>0 – 5</td>
<td>.29</td>
</tr>
</tbody>
</table>
Table 2 presents the relevant descriptive statistics for drinking days only. Results show that when participants did drink, they were on average consuming 2.86 standard drinks and described their affect as happy and relaxed. The most common motivations reported during drinking episodes was social and enhancement motivation.

### Table 2

**Descriptive Data for Key Study Variables on Drink Days**

<table>
<thead>
<tr>
<th>Level</th>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>Range</th>
<th>ICC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Momentary</td>
<td>Standard Drink</td>
<td>2.86</td>
<td>2.51</td>
<td>1 – 15</td>
<td>.04</td>
</tr>
<tr>
<td></td>
<td>Motive – Enhancement</td>
<td>1.29</td>
<td>1.45</td>
<td>0 – 5</td>
<td>.36</td>
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<td></td>
<td>Motive – Social</td>
<td>1.35</td>
<td>1.57</td>
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<td>.18</td>
</tr>
<tr>
<td></td>
<td>Motive – Cope</td>
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<td>1.30</td>
<td>0 – 5</td>
<td>.46</td>
</tr>
<tr>
<td></td>
<td>Motive – Conform</td>
<td>0.83</td>
<td>1.24</td>
<td>0 – 5</td>
<td>.24</td>
</tr>
<tr>
<td></td>
<td>Affect – Happy</td>
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<td>1.11</td>
<td>0 – 5</td>
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<tr>
<td></td>
<td>Affect – Relax</td>
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<td>0 – 5</td>
<td>.24</td>
</tr>
<tr>
<td></td>
<td>Affect – Stress</td>
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<td>1.48</td>
<td>0 – 5</td>
<td>.46</td>
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<tr>
<td></td>
<td>Affect – Irritated</td>
<td>1.41</td>
<td>1.29</td>
<td>0 – 5</td>
<td>.39</td>
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<td></td>
<td>Evening Plans</td>
<td>0.52</td>
<td>0.47</td>
<td>0 – 1</td>
<td>.10</td>
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<td></td>
<td>Others’ Alcohol Use</td>
<td>1.27</td>
<td>1.61</td>
<td>0 – 6</td>
<td>.01</td>
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</tbody>
</table>

Note. ICC = intraclass coefficients. Standard Drink is defined as consumption of an alcoholic beverage with 10 grams of alcohol. As the data are aggregated at the level of the day, the maximum range of alcohol intake was 15. Evening plans were coded as 0 = non-social, 1 = social. Others’ Alcohol Use refers to the individual being around others who were drinking.

The bivariate correlations are presented in Table 3. Results showed number of standard drinks and alcohol use (yes/no) was significantly, positively correlated with a number of momentary factors; the four momentary drinking motives, relaxed and happy affect, social plans and being with others who were drinking. At the dispositional level, conformity motivation was positively associated with both drinking outcomes.
### Table 3
**Bivariate Correlations for Key Study Variables**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Standard Drinks</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drink Yes/No</td>
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<td></td>
</tr>
<tr>
<td>Momentary Enhance</td>
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<td>.16**</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Momentary Social</td>
<td>.24**</td>
<td>.18**</td>
<td>.63**</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Momentary Cope</td>
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<td>.10**</td>
<td>.71**</td>
<td>.33**</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Momentary Conform</td>
<td>.21**</td>
<td>.17**</td>
<td>.50**</td>
<td>.69**</td>
<td>.33**</td>
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<tr>
<td>Momentary Happy</td>
<td>.06*</td>
<td>.07*</td>
<td>-22**</td>
<td>.04</td>
<td>-39**</td>
<td>.00</td>
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<td>Momentary Relax</td>
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<td>.08**</td>
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<td>.08**</td>
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<tr>
<td>Momentary Stress</td>
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<td>-.03</td>
<td>.28**</td>
<td>.05</td>
<td>.43**</td>
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<tr>
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<td>.02</td>
<td>.33**</td>
<td>.08**</td>
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<td>.15**</td>
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<td>.65**</td>
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<td>.12**</td>
<td>.20**</td>
<td>.41**</td>
<td>.06</td>
<td>.24**</td>
<td>.13**</td>
<td>.08**</td>
<td>-10**</td>
<td>-08*</td>
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<tr>
<td>Others’ Alcohol Use</td>
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<td>.58**</td>
<td>.11**</td>
<td>.20**</td>
<td>.04</td>
<td>.20**</td>
<td>.06*</td>
<td>.11**</td>
<td>-.05</td>
<td>.01</td>
<td>.12**</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Disposition Enhance</td>
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<td>-.05</td>
<td>.16**</td>
<td>.11**</td>
<td>.07*</td>
<td>.05</td>
<td>-.01</td>
<td>.07*</td>
<td>.02</td>
<td>.05</td>
<td>.02</td>
<td>-.00</td>
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<td>.01</td>
<td>.22**</td>
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<td>.00</td>
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</tr>
<tr>
<td>Disposition Cope</td>
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<td>.04</td>
<td>.36**</td>
<td>.21**</td>
<td>.40**</td>
<td>.15**</td>
<td>-22**</td>
<td>-13**</td>
<td>.28**</td>
<td>.26**</td>
<td>.03</td>
<td>.03</td>
<td>.47**</td>
<td>.54**</td>
<td></td>
</tr>
<tr>
<td>Disposition Conform</td>
<td>.16**</td>
<td>.14</td>
<td>.23**</td>
<td>.21**</td>
<td>.24**</td>
<td>.32**</td>
<td>-.07*</td>
<td>-.01</td>
<td>.14**</td>
<td>.18**</td>
<td>.08**</td>
<td>.09**</td>
<td>.13**</td>
<td>.34**</td>
<td>.22**</td>
</tr>
</tbody>
</table>

*Note.* Standard Drink is defined as an alcoholic beverage with 10 grams of alcohol per drink. Drink Yes/No is coded as 0 = no drinking that day, 1 = drinking that day. Evening plans are coded as 0 = non-social, 1 = social. Others’ Alcohol Use refers to the individual being around others who were drinking. To control for the multiple correlations undertaken a more stringent alpha rate of .01 was adhered to.

* p < .05  
** p < .01
3.4. Hurdle Models

3.4.1. Predicting Alcohol Consumption (Yes/No)

The likelihood that an individual would consume alcohol was most strongly related to whether others were drinking (OR = 9.83; see Table 4), followed by drinking for momentary enhancement motivation (OR = 1.45). At the dispositional level, being motivated to drink for conformity reasons was positively associated with alcohol consumption (OR = 1.17).

Table 4: Multilevel Logistic Regression Predicting Alcohol Consumption from Momentary and Dispositional Predictors

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>p</th>
<th>95% CI</th>
<th>Odds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Momentary</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-2.41**</td>
<td>&lt;.001</td>
<td>-2.87 – -1.95</td>
<td>0.09</td>
</tr>
<tr>
<td>Weekend</td>
<td>0.03</td>
<td>.89</td>
<td>-0.43 – 0.50</td>
<td>1.03</td>
</tr>
<tr>
<td>Evening Plans</td>
<td>0.28</td>
<td>.32</td>
<td>-0.27 – 0.83</td>
<td>1.32</td>
</tr>
<tr>
<td>Others’ Alcohol Use</td>
<td>2.29**</td>
<td>&lt;.001</td>
<td>1.72 – 2.85</td>
<td>9.83</td>
</tr>
<tr>
<td>Motive – Enhance</td>
<td>0.37*</td>
<td>.02</td>
<td>0.05 – 0.69</td>
<td>1.45</td>
</tr>
<tr>
<td>Motive – Social</td>
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<td>.32</td>
<td>-0.45 – 0.15</td>
<td>0.86</td>
</tr>
<tr>
<td>Motive – Cope</td>
<td>0.15</td>
<td>.45</td>
<td>-0.23 – 0.53</td>
<td>1.17</td>
</tr>
<tr>
<td>Motive – Conform</td>
<td>0.01</td>
<td>.98</td>
<td>-0.36 – 0.37</td>
<td>1.01</td>
</tr>
<tr>
<td>Affect – Happy</td>
<td>0.31</td>
<td>.90</td>
<td>-0.05 – 0.68</td>
<td>1.37</td>
</tr>
<tr>
<td>Affect – Relaxed</td>
<td>-0.05</td>
<td>.76</td>
<td>-0.35 – 0.26</td>
<td>0.95</td>
</tr>
<tr>
<td>Affect – Stressed</td>
<td>-0.07</td>
<td>.60</td>
<td>-0.35 – 0.20</td>
<td>0.93</td>
</tr>
<tr>
<td>Affect – Irritated</td>
<td>0.05</td>
<td>.74</td>
<td>-0.25 – 0.35</td>
<td>1.05</td>
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<tr>
<td>Dispositional</td>
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</tr>
<tr>
<td>Motive – Enhance</td>
<td>-0.02</td>
<td>.58</td>
<td>-0.07 – 0.03</td>
<td>0.98</td>
</tr>
<tr>
<td>Motive – Social</td>
<td>-0.05</td>
<td>.31</td>
<td>-0.12 – 0.02</td>
<td>0.95</td>
</tr>
<tr>
<td>Motive – Cope</td>
<td>0.07</td>
<td>.19</td>
<td>-0.04 – 0.10</td>
<td>1.07</td>
</tr>
<tr>
<td>Motive – Conform</td>
<td>0.15**</td>
<td>&lt;.01</td>
<td>0.09 – 0.21</td>
<td>1.17</td>
</tr>
</tbody>
</table>

Note. Outcome is coded as 0 = no drinking that day, 1 = drinking that day. Evening plans are coded as 0 = non-social, 1 = social. Others’ Alcohol Use refers to the individual being around others who were consuming alcohol.
*p <.05. **p <.01.

3.4.2. Hurdle Model b: Predicting the Quantity of Alcohol Consumed (1, 2, 3... drinks)

At the momentary level, the strongest positive predictor of the quantity of alcohol consumed was being surrounded by others’ who were drinking (B = 0.23; See
Table 5) and social evening plans ($B = 0.32$). At the dispositional level, drinking to conform was positively related to alcohol quantity ($B = 0.03$).

### Table 5

**Multilevel Zero-Truncated Regression Predicting Alcohol Quantity from Momentary Predictors and Dispositional Predictors**

<table>
<thead>
<tr>
<th></th>
<th>$B$</th>
<th>$S\bar{E}$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Momentary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-0.00</td>
<td>.17</td>
<td>.98</td>
</tr>
<tr>
<td>Weekend</td>
<td>0.07</td>
<td>.14</td>
<td>.65</td>
</tr>
<tr>
<td>Evening Plans</td>
<td>0.32*</td>
<td>.15</td>
<td>.04</td>
</tr>
<tr>
<td>Others’ Alcohol Use</td>
<td>0.23**</td>
<td>.03</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Motive – Enhance</td>
<td>0.17</td>
<td>.09</td>
<td>.06</td>
</tr>
<tr>
<td>Motive – Social</td>
<td>-0.03</td>
<td>.08</td>
<td>.68</td>
</tr>
<tr>
<td>Motive – Cope</td>
<td>-0.19</td>
<td>.11</td>
<td>.08</td>
</tr>
<tr>
<td>Motive – Conform</td>
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<td>.08</td>
<td>.17</td>
</tr>
<tr>
<td>Affect – Happy</td>
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<td>Affect – Relaxed</td>
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<td>.45</td>
</tr>
<tr>
<td>Affect – Irritated</td>
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<td>.97</td>
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</tbody>
</table>

<table>
<thead>
<tr>
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<th>$B$</th>
<th>$S\bar{E}$</th>
<th>$p$</th>
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</thead>
<tbody>
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<td>Dispositional</td>
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<td>.71</td>
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<td>Motive – Social</td>
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<tr>
<td>Motive – Cope</td>
<td>0.02</td>
<td>.02</td>
<td>.26</td>
</tr>
<tr>
<td>Motive – Conform</td>
<td>0.03*</td>
<td>.01</td>
<td>.03</td>
</tr>
</tbody>
</table>

**Note.** Outcome is coded as the number of Standard alcoholic beverages (10 grams of alcohol per drink) consumed on a drinking day. Evening plans are coded as (0 = non-social, 1 = social). Others’ Alcohol Use refers to the individual being around others who were drinking. *$p < .05$. **$p < .01$.

### 4. Discussion

This is the first study to examine to what extent dispositional drinking motives and features of the drinking situation interact to predict the initiation of alcohol consumption and/or the quantity of alcohol consumed. Interestingly, the findings identified social factors and drinking motives as primary determinants in the prediction of drinking behaviors with affect playing less of a role than expected.

#### 4.1. Main Findings

The main finding that emerged from this study was that the social context was the strongest predictor of both alcohol initiation, and consumption. Specifically, being surrounded by others who were drinking increased the likelihood that the individual would drink, by more than nine times, in comparison to contexts in which the individual...
was not surrounded by other people drinking. This finding is consistent with prior observational studies showing young people drink in a manner that matches how their own social group is drinking (Borsari, Murphy, & Barnett, 2007; Thrul & Kuntsche, 2016). However, this study extends these findings by demonstrating the social context as related to both, the initial decision to use alcohol, and the decision to continue drinking. With the substantial amount of variance that social context explained in both forms of drinking behavior, it appeared negative and positive affect were not significantly related to either drinking outcome, despite prior evidence that suggests affect is one of the strongest predictors of young adult’s drinking (Armeli et al. 2014; Goldsmith, Tran, Smith, & Howe, 2009). Taken together, this EMA study provides important evidence that young people’s drinking behavior is most strongly influenced by the nature of the social context, more so than their internal affective state.

The second important finding is that momentary enhancement motivation was positively predictive of alcohol initiation but not continued alcohol consumption. This suggests that those who are motivated to drink, in order to enhance their positive affect, will be more likely to initiate alcohol use, but not necessarily more likely to engage in continued drinking. Interestingly, this contrasts with cross-sectional studies that have found dispositional enhancement motives as predictive of heavy drinking patterns (Kuntsche, Knibbe, Gmel, & Engels, 2006; Müller & Kuntsche, 2011) and daily diary studies (O’Hara et. al., 2014; 2015) which found momentary enhancement motivation as predictive of risky drinking. It appears that when enhancement motives are measured in the moment, and alcohol use is separated into ‘initiation of use’ and ‘continued use’, some interesting differences are revealed. This may suggest that enhancing one’s affect is achieved by the act of initiating alcohol use (e.g., due to celebratory toast or the flavor of alcohol) but not necessarily related to continued alcohol use, as this could interfere with the enhancement of one’s affect through the experience of adverse consequences
(e.g., feeling sick or acting inappropriately). Further research is required to confirm the role that momentary enhancement motives play in the prediction of different forms of drinking behavior.

Finally, dispositional conformity drinking motivation was the only trait-level factor predictive of drinking behaviors; those who were motivated to drink as a way to conform with others, initiated more drinking episodes and consumed a higher quantity of alcohol compared to those who drank for different dispositional motivations. This is an interesting finding given prior research tends to find dispositional conformity motives, as either unrelated to alcohol use (Gonzalez, Collins, & Bradizza, 2009; Smit, Groefsema, Luijten, Engels, & Kuntsche, 2015) or negatively related to alcohol use (Cooper, 1994; Kuntsche et al., 2014). It has been suggested that the effects of conformity motives depend on the type of social context the individual is in and the drinking norms exhibited (Kuendig & Kuntsche, 2013). Given the current sample commonly reported being surrounded by other people who were drinking, it is possible that those who were also motivated to conform were at a higher likelihood of engaging in drinking behaviors as they adapted their drinking behaviours to match the norms present in the social context.

4.2. Limitations and Future Research Directions

A number of limitations warrant consideration. Compliance to the app was moderate at about 60% with a clear trend of higher engagement earlier in the EMA phase. Although Fuller-Tyszkiewicz and colleagues (2013) demonstrate that a moderate compliance rate is not necessarily indicative of poorer quality data, the current findings which follow this trend of less engagement over time, suggest that there may have been inherent issues in the design of the app (e.g., the study duration of 21 days, with three daily alerts could be burdensome). Further research is essential to identify what the best
methods are to obtain a high level of quality engagement from participants in EMA studies.

A further limitation of this study was our brief measure of social context which only included two items; the young person’s plans for the evening and if they were with other people who were drinking. This measure failed to capture the specific composition of who the person was with (e.g., demographics, relationship) and the precise drinking behavior of the group (e.g., low or high alcohol consumption). Future studies should examine the specific composition of the interpersonal context and how this influences an individual’s alcohol consumption.

4.3. Implications

Drinking-based interventions for young people tend to focus on increasing motivation to change (e.g., Vasilaki, Hosier, & Cox, 2006), or reducing negative affect using cognitive-behavior therapy (e.g., Carey, Scott-Sheldon, Carey, & DeMartini, 2007). However, these findings indicate that it is the peer group surrounding the young person which is the primary factor in determining their decision to drink, and how much. An Ecological Momentary Intervention (EMI) that delivers harm minimization strategies during peer drinking situations is a potential way forward in reducing risky drinking in young people. This design is advantageous as the delivery of the intervention is close in time to the high-risk trigger (peer drinking group) which research identifies as highly effective in changing behaviours (e.g., Johnson, Jackson, Guillaume, Meier, & Goyder, 2010).

4.4. Conclusion

This paper is the first of its kind to examine the role that key momentary determinants have in the prediction of distinct drinking behaviours. Interestingly, compared to cross-sectional and daily diary studies, our study highlights that the key determinant underpinning a young person’s decision to drink and how much they drink,
is the interpersonal context they are exposed to. An examination that tests the extent to which conformity dispositional drinking motives moderates the relationship between the interpersonal context and initiation of alcohol use and continued consumption, would be an important addition to this important field of work.
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Appendix 4.3

Please refer to Table 1 for the number of standard drinks consumed by time of assessment.

<table>
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<th>Time</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<td>0</td>
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<td>0</td>
<td>1</td>
</tr>
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<td>5</td>
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<td>3</td>
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540
CHAPTER FIVE: TAILORED SMARTPHONE INTERVENTION: A RANDOMISED CONTROLLED TRIAL AND USABILITY STUDY

Overview

Traditionally, alcohol-reduction interventions available to young adults include Motivational Interviewing (MI) or Cognitive Behavioural Therapy (CBT), which aim to modify cognitions regarding alcohol use and are delivered by a therapist in a health care service setting (Carey, Scott-Sheldon, Carey, & DeMartini, 2007). However, as the findings from Chapter Four and recent Ecological Momentary Assessment (EMA) studies show, the strongest predictors of young adults’ drinking behaviours are not stable factors (i.e., dispositional drinking motivations), but rather dynamic factors within the drinking context (i.e., momentary affect, Dvorak, Pearson, & Day, 2014; social interpersonal factors, Kuntsche, Otten, & Labhart, 2015). Given these risk factors occur within the drinking context (rather than just within the person), intervention is required that extends beyond the standard treatment context (e.g., therapist office) and offers real-time support during the moments when the risk factors are present. A further limiting feature of these traditional forms of alcohol interventions is that the young person is required to initiate professional help in primary and secondary health care settings. Young people experiencing drinking-related problems underutilise professional treatment for a variety of reasons (e.g., shame, financial reasons, geographical barriers, etc.) (e.g., Hunt & Eisenberg, 2010; Wu, Pilowsky, Schlenger, & Hasin, 2007). Finding useful, accessible and confidential ways to reduce risky drinking among young people remains a key research and health priority.

10 This empirical study is under review. O’Donnell, Richardson, Fuller-Tyszkiewicz, & Staiger, (2018). A Smartphone Intervention that Delivers Tailored Protective Drinking Strategies to Young Adults who Engage in Risking Drinking: A Randomised Controlled Trial. International Journal of Behavioral Medicine. Refer to Appendix 5.8.
This pilot study reports on the evaluation of a smartphone-delivered intervention that targets situation-specific risk factors which are known to precipitate young adults’ risky drinking. The evaluation of the intervention occurred in two parts as per guidelines described by the Medical Research Council (National Health and Medical Research Council, 2013); (1) using a randomised controlled trial, the efficacy of the intervention was examined, and (2) employing a qualitative study design, the usability and acceptability of the intervention was evaluated.

**Protective Behavioural Strategies**

One approach that has shown promise when used as part of a multi-component alcohol-reduction intervention is Protective Strategies (PBS); simple behavioural techniques designed to reduce drinking and/or drinking-associated harm such as drink driving (Martens, Pederson, LaBrie, Ferrier, & Cimini, 2007). PBS (Martens et al., 2005) may be separated into three subtypes: stopping or limiting consumption (e.g., setting drinking limits), changing the manner of drinking (e.g., avoiding drinking games, drinking beer instead of spirits), and avoiding serious hazards associated with drinking (e.g., organizing a designated driver).

**Evidence for Protective Behavioural Strategies**

Cross-sectional evidence suggests that individuals who participate in interventions employing PBS as well as other components (e.g., personalised feedback regarding drinking levels, information on drinking-consequences), are less inclined to drink in a risky manner Martens et al., 2007; Sugarman & Carey, 2007). For example, a recent study by Barnett, Murphy, Colby, and Monti, (2007) found that participants who were provided with a multi-component brief intervention that included personalised feedback, enhancement of motivation, goal development, and PBS, meaningfully reduced the number of heavy drinking days (in the prior 30 days), three months after the intervention ($M=2.56$ heavy drinking days, $SD=3.26$) as compared to baseline ($M=3.05$...
heavy drinking, $SD=4.05$). Focused evaluations of PBS have also shown it to be an effective mediator within multicomponent interventions (e.g., Dimeff, 1999; Martens et al., 2004). For example, Larimer and colleagues (2007) found that PBS mediated intervention effectiveness, with participants who received personalized feedback regarding their drinking behaviour as more likely to reduce their alcohol use if they were also provided with protective strategies compared to those who were not provided with protective strategies.

Despite PBS showing promise within multicomponent intervention contexts, when delivered as a standalone intervention (without other intervention components), it is not as effective (LaBrie et al., 2015; Martens et al., 2013). For example, LaBrie and colleagues found that 1-month post-intervention, participants who had received the PBS intervention showed no meaningful difference in the maximum number of drinks they had consumed on a single occasion in the prior 30 days ($M=7.25$ number of drinks, $SD=3.93$) compared to a control group ($M=7.91$ number of drinks, $SD=4.09$).

Two reasons may account for these weak findings regarding the application of PBS as a stand-alone intervention. First, a single delivery of PBS at one point in time is unlikely to be sufficient to facilitate sustained change in an individual’s drinking habits. Rather, repetition and consistent reminders of these strategies may better facilitate behavior change (Gardner et al., 2012; Wood & Neal, 2007). Second, these psychoeducational interventions did not tailor the provision of PBS to the individual’s drinking context, their momentary affective state or the types of drinking-based goals they wanted to achieve (e.g., reduction in consumption or drinking-related consequences).

**Factors to Inform Drinking Interventions**
Evidence from Chapter Four and Recent EMA studies (Dvorak, Pearson, & Day, 2014; Kuntsche, Otten, & Labhart, 2015) have shown momentary affect and social interpersonal factors within the drinking context as significant determinants of young adults’ drinking behaviors. Dvorak and colleagues found daily negative affect predictive of subsequent heavy drinking, whereas daily positive affect was predictive of drinking-related harm. Thus, whether the valence of affect is negative or positive may have important implications for either heavy drinking or drinking-related harm. In terms of the social interpersonal context, Kuntsche and colleagues found young adults who experienced social situations marked by interactions with same-sex friends at drinking establishments, as more likely to drink in a risky manner, compared to when they were not exposed to these types of situations. Finally, health behavior change interventions are enhanced with the inclusion of goal-setting. Indeed, there is a significant body of research that supports the applicability and utility of goal-setting within alcohol behavior change (Adamson et al., 2010 and Moos, 2007). As such, implementation of PBS interventions should be sufficiently flexible to tailor messages and strategies to individuals’ momentary affect, social drinking context, and drinking-related goal.

**Ecological Momentary Intervention**

Ecological Momentary Intervention (EMI) is defined as a method to intervene upon behavior in the moment (Heron & Smyth, 2010) via a mobile device. EMI enables the delivery of a PBS-based intervention tailored to individuals’ affective state, social context, and their drinking-related goal. This in-the-moment modality offers many advantages over traditional intervention formats (e.g., therapist delivered), including: (a) EMIs can use EMA data to provide support that is personalised and tailored to the individual’s context (Nahum-Shani et al., 2014) and; (b) Using “decision rules”, EMI can deliver information in a timely manner close to the target behaviour (e.g., Cerrada et al. 2017), which is more effective than delayed interventions (e.g., Johnson, Jackson,
Guillaume, Meier, & Goyder, 2010). Due to this functionality, smartphone apps have the capacity to support the individual when they most need help, which is extremely important for substance-misuse behaviours (Dahne, & Lejuez, 2015). Given these benefits, there has been a surge in the number of EMIs delivered via smartphone apps, to reduce risky drinking behaviours for both non-dependent drinkers (Garnett, Crane, West, Brown, & Michie, 2018; Wright, Dietze, Crockett, & Lim, 2016) and dependent drinkers (Gustafson et al., 2014).

**Current Study**

The EMI framework provides a number of strengths in delivering alcohol reduction interventions. Though as yet, an EMI that delivers PBS that are tailored to an individual’s goals and drinking context, in the moment, has not been trialled. To address this, *Minimise* was developed by our research team to deliver a range of PBS over a sustained period of time (28 days), tailored to the user’s drinking goal (i.e., reduce alcohol and/or drinking-related consequences), their momentary affective state (i.e., negative or positive) and their social, interpersonal context (i.e., who they are with). The principal part of this pilot study (Part One) is to assess the efficacy of this intervention using a randomised controlled trial. The specific Research Questions (RQs) of this component of the study include;

RQ1: To what extent do individuals who receive *Minimise* report a reduction in the two primary outcomes of frequency of Risky Single Occasion Drinking (RSOD, five or more Standard Drinks consumed in a single setting) and alcohol-related harms (e.g., interpersonal disputes) compared to individuals in the control group?

RQ2: To what extent do individuals who receive the *Minimise* app exhibit an increase in the secondary outcome of frequency of PBS use in comparison to those in the control group?
The secondary aim of this study (Part Two) is to explore the usability and acceptability of the *Minimise* application. In particular, the objective of this component of the study includes:

RQ3: To what extent do users of *Minimise* perceive the app as a usable device to facilitate reductions in risky drinking behaviours?

RQ4: To what extent do users of *Minimise* perceive the app as an acceptable device to reduce risky drinking behaviours?

**Part One Efficacy**

**Method**

**Trial Design**

To examine preliminary efficacy of *Minimise* (RQ1 and RQ2), a single-blind, randomised controlled trial using a two-arm parallel sequence in which the primary outcomes (drinking behaviors) and secondary outcomes (PBS use) were measured at baseline and immediately post the intervention. This study was approved by the authors’ Ethics Committee board, and all procedures were in accordance with the National Health and Medical Research Council (National Statement on Ethical Conduct in Human Research 2018). Refer to Appendix 5.5 for Consolidated Standards of Reporting Trials Checklist.

**Randomisation and Blinding**

Following screening and completion of the baseline questionnaire, eligible participants were randomly assigned to the intervention or control group using a pre-determined computerised sequence by Qualtrics ([www.qualtrics.com](http://www.qualtrics.com)). At the end of the baseline questionnaire, the presentation of the app-download instructions was randomised, alternating between how to download the self-monitoring ‘*InstantSurvey*’ smartphone app (Richardson, 2015) or the intervention, ‘*Minimise*’ app. Participants

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11 This trial is registered at Australia and New Zealand Clinical Trials Register: ACTRN12616001231437
were fully blinded as to which group they were assigned to (i.e., they did not know which app corresponded to the intervention or control group). Once participants had completed the follow-up assessment (immediately post the intervention period), they were informed as to which group they were in and debriefed. Those in the control group were offered the intervention app (Minimise) after the debrief.

**Study Population**

Participants were recruited via invitations on social media (e.g., Facebook), and from advertisements placed within a large metropolitan university campus. Participants were eligible for the trial if they answered yes to the following criteria in the baseline survey; (a) aged 18-35 years; (b) access to an iPhone; (c) reported being motivated to reduce alcohol use and; (d) consume alcohol, on average, at least once a week.

**Participants**

**Intervention**

A total of 25 individuals aged between 18 and 35 years (18 females; $M_{age}=21.36$ years, $SD_{age}=4.15$ years) completed the baseline assessment and were randomised to download the Minimise app (see Fig 1). After downloading the app, three participants were lost to follow-up. Participants who were lost at follow-up did not differ from those who completed follow up on the following characteristics; age (Completed Follow Up $M_{age}=21.23$ years, $SD_{age}=4.01$ years; Incomplete Follow Up $M_{age}=22.67$ years, $SD_{age}=6.35$ years) sex (Completed Follow Up $M_{sex}=1.64^{12}$, $SD_{sex}=.492$; Incomplete Follow Up $M_{sex}=2.00$, $SD_{sex}=0$) and AUDIT total score (Completed Follow Up $M_{AUDIT}=11.73$, $SD=3.69$; Incomplete Follow Up $M_{AUDIT}=9.67$, $SD_{AUDIT}=1.53$). The total number of participants who completed all phases of the intervention study (i.e., baseline and follow-up) was 22.

**Control**

\[12 \] 2.00 was allocated to female participants and 1.00 was allocated for male participants
A total of 20 individuals aged between 18 and 32 years (18 females; $M_{\text{age}}=22.75; SD_{\text{age}}=4.41$) completed the baseline assessment and were randomised to download the *InstantSurvey* app (see Figure 1). After downloading the app, four participants were lost to follow-up. Participants who were lost at follow up did not differ from those who completed follow up on the following characteristics; age (Completed Follow Up $M_{\text{age}}=22.69$ years, $SD_{\text{age}}=4.30$ years; Incomplete Follow Up $M_{\text{age}}=23.50$ years, $SD_{\text{age}}=5.20$ years) and sex (Completed Follow Up $M_{\text{sex}}=1.94$, $SD_{\text{sex}}=.25$; Incomplete Follow Up $M_{\text{sex}}=1.75$, $SD_{\text{sex}}=.50$). Participants who dropped out before follow-up did exhibit a higher AUDIT total score ($M_{\text{AUDIT}}=13.25$, $SD_{\text{AUDIT}}=6.30$) compared to those who completed the follow up assessment ($M_{\text{AUDIT}}=9.67$, $SD_{\text{AUDIT}}=1.53$). A total of 16 participants completed all phases of the control study (i.e., baseline and follow-up).
**Intervention App**

*Minimise,* is a smartphone app that delivers PBS tailored to the users’ goals and drinking context. On first use, *Minimise* will ask the user which goals they want to achieve from the app; (a) reduce the amount of alcohol they consume and/or (b) reduce their experience of adverse drinking-related consequences (see Appendix 5.1, Figure 1). Once the goals are selected this information is stored in the app and informs the algorithm of PBS delivery (detailed below). Following this, the user receives two messages per day, once at 11:00am and again at 8:00pm, for 28 consecutive days. These messages ask the user to complete a short self-monitoring survey which examines; (a)
drinking behaviors: current drinking intention (i.e., *do you intend to drink today?*), if alcohol had been consumed since the last assessment and if so how much (on a 1-10 scale), if the user has experienced adverse drinking-related consequences (i.e., *work/study, unwell, interpersonal difficulties*); (b) drinking context: social interpersonal context (i.e., *are you with other people or alone*?), positive affect (i.e., *do you feel happy?*) and negative affect (i.e., *do you feel stressed?*) and; (c) PBS use for alcohol consumption (i.e., *did you use a strategy to manage your alcohol use?*) and drinking-related harm (i.e., *did you use a strategy to manage drinking-related harm?*)

During this short self-monitoring survey, if the user indicates that they are drinking or that they intend to drink they immediately receive a message alerting them to “please review your strategies”, which is located under the ‘strategies’ tab within the app (see Appendix 5.1, Figure 2). Three strategies are delivered within the app and tailored to the users; (i) goals (i.e., to reduce alcohol use and/or alcohol harm), (ii) current affect (i.e., positive or negative affect), and (iii) social context (i.e., alone or with other people; refer to Appendix 5.3 to view algorithm in detail). While *Minimise* includes a total of 21 different PBS built into the app, only three PBS were delivered per drinking event. Of the 21 strategies embedded within Minimise, 11 were derived from the PBS Scale (Martens et al., 2005), while 10 strategies were developed for this study (Appendix 5.3). In addition, *Minimise* allows the user to access their drinking statistics at any time (including percentage of days of PBS use, percentage of days of risky drinking etc.; refer to Appendix 5.1, Figure 3).

**Control App**

*InstantSurvey* is a smartphone application that comprises alcohol self-monitoring functions (see Appendix 5.2 for screenshots of these functions). Similar to *Minimise*, the app delivers two messages per day, once at 11:00am and again at 8:00pm, for 28 consecutive days. This message asks the user to complete a short self-monitoring survey
which examines similar items as the Minimise app (i.e., drinking behaviors and drinking context). The InstantSurvey app does not provide any information regarding PBS.

**Measures**

Using an online survey, the following was assessed at baseline; basic demographics (i.e., age and gender), the Alcohol Use Disorders Identification Test (AUDIT), primary and secondary outcomes. Immediately post the intervention, the primary and secondary outcomes were reassessed.

The AUDIT was used to identify the level of drinking-related problems exhibited by the sample at baseline (Saunders, Aasland, Babor, & De La Fuente, 1993). The AUDIT is a 10-item questionnaire that examines consumption, dependence, and drinking-related problems ($\alpha = 0.79$). Items 1 to 8 are scored on a 5-point rating scale ($0 = never, 5 = daily$) and questions 9 to 10 are scored on a 3-point rating scale ($0 = no, 2 = yes, in the past year$). Research indicates that AUDIT scores from 8 to 15 represent a moderate level of risky drinking, with scores above 15 being representative of more problematic use (Donovan, Kivlahan, Doyle, Longabaugh, & Greenfield, 2006).

**Primary Outcome**

To assess the primary outcomes regarding the frequency of RSOD and drinking-related harms, the following questions were asked: ‘over the past two weeks how many times did you; (a) consume more than four Australian Standard Drinks (ASDs; 10g ethanol); (b) experience difficulties with work and/or study due to your drinking (RSOD); (c) experience interpersonal difficulties due to your drinking; and (d) felt physically unwell due to your drinking. Items were scored on a 4-point rating scale ($0= never, 1 = 1-2 times, 2 = 3-4 times, 3= more than 4 times$).

**Secondary Outcome**

To assess the secondary outcomes regarding the frequency of applying PBS, participants were asked, ‘over the past two weeks how many times did you... ’: (a) use a
PBS to control the amount of alcohol you drank (PBS alcohol), and; (b) use a PBS to reduce harm when drinking (PBS harm). Items were scored on a 4-point rating scale (0= never, 1 = 1-2 times, 2 = 3-4 times, 3= more than 4 times).

Sample Size

Sample size calculations were conducted using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007). Comparable interventions (e.g., Arnaud et al., 2017; Haug et al., 2017) have found moderate effects for post-intervention drinking outcomes and harms (Cohen’s $d = .25$). Moreover, this calculation assumes a correlation between baseline and follow up of .60 of the primary outcome variables (i.e., alcohol consumption and drinking harm; Napper, Kenney, Lac, Lewis, & LaBrie, 2014; Wiers, Van De Luitgaarden, Van Den Wildenberg, & Smulders, 2005). With the alpha set at .05 and power at .80, a total sample of 28 individuals was needed.

Results

Data Analytic Procedure

For the preliminary analyses, independent sample $t$ tests were employed to determine if there were differences in the baseline characteristics of age and AUDIT total score and a Pearson’s chi-square was used to assess if there were differences in the gender proportions between the groups (i.e., intervention and control). For the main analysis, mixed-effect models were used assess the influence of time, group and interaction of time * group on the primary and secondary outcomes. In each model, intercept and time were included as random effects and group was modelled as a fixed effect. Furthermore, a Poisson distribution was used in these mixed models given the outcomes were measured as count variables (e.g., frequency of risky drinking in the prior two weeks).

Missing values were evident at follow-up for both the primary and secondary outcome variables (see Appendix 5.4 for more information). Little’s Missing
 Completely at Random test revealed the data across each of the outcomes was missing completely at random; \( X^2 (2, N=45) = 6.09, p = .99 \). Therefore, all available data were used in the main analyses using maximum likelihood estimation. Analyses were performed using Mplus (Muthén & Muthén, 2011).

**Adherence Statistics**

Adherence with the app was calculated as the percentage of days the individual was engaged with the app, out of the possible 28. For the intervention group, a total of 25 participants responded to 953 prompts, out of a possible 1,400 prompts (68%) across 552 days (out of a possible 700). On average, participants in the intervention group engaged with the app on 22.08 days (SD=9.70) out of a possible 28, giving an adherence rate of 79%. Participants in the intervention group provided close to two reports per day (\( M= 1.72; SD=0.63 \)) out of two. Preliminary analyses were conducted to evaluate whether adherence (i.e., total number of days responded to the app) was influenced by age and gender, and whether adherence was associated with a difference in outcomes at follow-up. The results found adherence to the *Minimise* app was unrelated to age (\( r = .20, p = .40 \)) and gender (\( r = .24, p = .30 \)). Furthermore, adherence to *Minimise* was not significantly related to changes in any of the outcomes at follow-up (RSOD, \( r = .14, p = .56 \); Work Difficulties, \( r = -.12, p = .61 \); Interpersonal, \( r = -.25, p = .28 \); Unwell, \( r = .01, p = .96 \); PBS Alcohol Use, \( r = .02, p = .94 \); PBS Harm, \( r = -.16, p = .48 \)). This suggests that there was no difference in outcomes at follow-up for those who engaged in *Minimise* more so than others.

The 20 participants in the control group responded to 906 prompts (out of a possible 1,120; 81%), across 442 days of self-monitoring (out of 560). On average, participants in the control group reported a response on 22.1 days out of 28 (SD=8.55), giving an adherence rate of 79%. Participants in the control group were providing close to two self-reports each day (\( M= 1.96, SD=0.50 \)) out of two. In terms of the
relationship between adherence and demographics, the findings revealed that adherence was not significantly related to gender \( (r = .37, p = .17) \), though was negatively correlated with age \( (r = -.56, p = .03) \), suggesting that older participants engaged with the app less than younger participants. Furthermore, results found that adherence to InstantSurvey was negatively correlated with changes at follow-up in the outcome of being unwell due to drinking \( (r = -.57, p = .03) \) and the frequency of PBS use for alcohol consumption \( (r = -.56, p = .03) \). There was no significant association between adherence and change in the other outcomes at follow-up (RSOD, \( r = -.29, p = .29 \); Work Difficulties, \( r = -.31, p = .26 \); Interpersonal, \( r = -.03, p = .91 \); PBS Harm, \( r = -.32, p = .25 \)).

**Preliminary Analysis**

Preliminary analyses were conducted to evaluate if there were significant differences observed across the groups for the baseline characteristics including; age, gender and AUDIT total score (as shown in Table 1). There were no significant differences between the groups for these demographic and alcohol-related measures.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Comparison of Demographic and Baseline Alcohol-Related Variables by Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
</tr>
<tr>
<td>Age – Mean (SD)</td>
<td>22.75 (4.41)</td>
</tr>
<tr>
<td>Gender – % (n)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>90% (18)</td>
</tr>
<tr>
<td>Male</td>
<td>10% (2)</td>
</tr>
<tr>
<td>AUDIT – Mean (SD)</td>
<td>14.10 (6.30)</td>
</tr>
</tbody>
</table>

**Main Analysis**

**Mean Differences Between Group and Time for Primary and Secondary Outcomes**

Sample means for the primary (i.e., RSOD and drinking-related harm) and secondary outcomes (i.e., PBS use for alcohol consumption and harm) at baseline and follow-up, across the groups (intervention and control), are presented in Table 2. There
were no significant differences at baseline in the primary or secondary outcomes across the intervention or control, suggesting that at baseline, the groups were similar to each other. At follow-up, there was no significant change in the primary outcomes across the groups. Whereas, for the secondary outcomes, participants in the intervention group were shown to endorse PBS for alcohol use ($M=1.61, SD=1.17$) and harm ($M=1.47, SD=0.22$) significantly more than those in the control group ($M=1.07, SD=0.20$; $M=0.63, SD=0.25$, respectively) at follow-up.
<table>
<thead>
<tr>
<th>Time</th>
<th>Group</th>
<th>T1</th>
<th>T2</th>
<th>T1 vs T2</th>
<th>T1</th>
<th>T2</th>
<th>T1 vs T2</th>
<th>T1 vs T1</th>
<th>T2 vs T2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Control</td>
<td>Control</td>
<td></td>
<td>Intervention</td>
<td>Intervention</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>n=20</td>
<td>n=16</td>
<td></td>
<td>n=25</td>
<td>n=22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RSOD</td>
<td></td>
<td>1.55 (.18)</td>
<td>1.18 (.20)</td>
<td>0.36</td>
<td>1.60 (.16)</td>
<td>1.50 (.17)</td>
<td>-0.10</td>
<td>.68</td>
<td>0.05</td>
</tr>
<tr>
<td>Work/Study Consequence</td>
<td>0.96 (.17)</td>
<td>0.59 (.19)</td>
<td>-0.37</td>
<td>.08</td>
<td>0.82 (.16)</td>
<td>0.60 (.16)</td>
<td>-0.22</td>
<td>.23</td>
<td>-0.13</td>
</tr>
<tr>
<td>Interpersonal Issues</td>
<td>0.61 (.17)</td>
<td>0.56 (.18)</td>
<td>-0.05</td>
<td>.80</td>
<td>0.51 (.15)</td>
<td>0.28 (.16)</td>
<td>-0.23</td>
<td>.16</td>
<td>-0.10</td>
</tr>
<tr>
<td>Physically Unwell</td>
<td>1.05 (.16)</td>
<td>0.98 (.17)</td>
<td>-0.07</td>
<td>.74</td>
<td>1.08 (.14)</td>
<td>0.83 (.15)</td>
<td>-0.25</td>
<td>.15</td>
<td>0.03</td>
</tr>
<tr>
<td>PBS Alcohol Use</td>
<td>1.10 (.18)</td>
<td>1.07 (.20)</td>
<td>-0.03</td>
<td>.91</td>
<td>1.00 (.16)</td>
<td>1.61 (.17)</td>
<td>0.61</td>
<td>.003</td>
<td>-0.10</td>
</tr>
<tr>
<td>PBS Alcohol Harm</td>
<td>0.99 (.23)</td>
<td>0.63 (.25)</td>
<td>-0.36</td>
<td>.21</td>
<td>1.04 (.21)</td>
<td>1.47 (.22)</td>
<td>0.43</td>
<td>.08</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Note. RSOD = Risky Single Occasion Drinking, consumption of more than 4 Standard Drink in a single setting. PBS = Protective Behavioural Strategies applied for alcohol use or alcohol-related harm. T1= baseline, T2= follow up.
Group by Time Main and Interaction Effects

The main and interaction effect of time and group upon the primary and secondary outcomes are evident in Table 3. There was no significant main or interaction effect of time or group upon the primary outcomes. There was a significant interaction of time by group in predicting changes in the secondary outcomes of PBS use for alcohol consumption ($B=.52$, $p=.03$), and PBS use for alcohol-related harm ($B=.82$, $p=.03$). Please refer to the graphical representation of these interactions in Appendix 5.6 for more information.

Table 3
Main and Interaction Effects of Time and Group upon Primary and Secondary Outcomes

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>SE</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSOD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>0.62</td>
<td>0.51</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>-0.32</td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>-0.01</td>
<td>0.30</td>
<td></td>
</tr>
<tr>
<td>Time * Group</td>
<td>0.11</td>
<td>0.20</td>
<td>0.01</td>
</tr>
<tr>
<td>Interpersonal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-1.29</td>
<td>1.38</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>0.58</td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>0.52</td>
<td>0.79</td>
<td></td>
</tr>
<tr>
<td>Time * Group</td>
<td>-0.59</td>
<td>0.48</td>
<td>0.02</td>
</tr>
<tr>
<td>Unwell</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-0.00</td>
<td>0.70</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>0.07</td>
<td>0.43</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>0.16</td>
<td>0.41</td>
<td></td>
</tr>
<tr>
<td>Time * Group</td>
<td>-0.16</td>
<td>0.26</td>
<td>0.02</td>
</tr>
<tr>
<td>Work/Study</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>0.66</td>
<td>0.77</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>-0.57</td>
<td>0.60</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>-0.24</td>
<td>0.51</td>
<td></td>
</tr>
<tr>
<td>Time * Group</td>
<td>0.10</td>
<td>0.38</td>
<td>0.01</td>
</tr>
<tr>
<td>PBS alcohol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>0.73</td>
<td>0.59</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>-0.55</td>
<td>0.43</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>-0.61</td>
<td>0.39</td>
<td></td>
</tr>
<tr>
<td>Time * Group</td>
<td>0.52*</td>
<td>0.25</td>
<td>0.02</td>
</tr>
<tr>
<td>PBS harm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>1.08</td>
<td>0.93</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>-1.22</td>
<td>0.66</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>-0.79</td>
<td>0.58</td>
<td></td>
</tr>
<tr>
<td>Time * Group</td>
<td>0.82*</td>
<td>0.38</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Note. RSOD = Risky Single Occasion Drinking, consumption of more than 4 Standard Drink (defined as consumption of an alcoholic beverage with 10 grams of alcohol). PBS = Protective Behavioural Strategies applied for alcohol use or alcohol-related harm.

$^* p < .05$

Part Two Usability and Acceptability
Method

Participants

Participants were selected based on obtaining a sample with an equal proportion of males and females and matched approximately for the mean age of the larger sample. The sample included three male and three female participants ($M_{age}=19.5$ years, $SD_{age}=1.64$ years) from the intervention group. Formative usability trials have demonstrated that a sample of five participants can identify 80% of usability issues (Lewis, 1994; Virzi, 1992).

Measures

Usability was assessed from the System Usability Scale (SUS, Brooke, 1996) and acceptability was examined through an interview schedule based on the Enlight measure (Baumel, Faber, Mathur, Kane, & Muench, 2017).

System Usability Scale

The SUS is an industry-standard 10-item scale (e.g., McLellan, Muddimer, & Peres, 2012) that examines the usability of a technological tool. Responses are measured on a 5-point Likert-type scale with 1 (strongly disagree) to 5 (strongly agree). The SUS yields a composite score between 0 and 100, with higher scores indicating higher perceptions of usability. A SUS score greater than 68 is considered ‘above average’ and consistent with satisfactory usability (e.g., Lewis, & Sauro, 2009). The SUS has been found as a reliable and valid tool among both experts and service users when assessing the usability of smartphone applications (Kortum & Bangor, 2013).

Enlight

A total of 10 open-ended questions were taken from the Enlight evaluation tool (Baumel et al., 2017) and posed to participants during a one-on-one phone interview. These questions were designed to gain an in-depth understanding into the acceptability and usability of the app. Example questions include: “to what extent is the app an
*appropriate tool to use in reducing alcohol use?*” and, “*how easy was it to learn to use the app?*”. 

**Procedure**

At the end of the intervention period, a subgroup of six participants engaged in a one-on-one phone interview with a trained research assistant who presented the following questions; basic demographics, the System Usability Scale, (SUS) and open-ended questions adapted from the Enlight Categories. The mean length of the interview was 35 minutes ($SD = 9.46$).

**Results**

**Thematic Analysis Procedure**

Thematic analysis was used to identify the recurring themes from the qualitative data, as outlined by Braun and Clarke (2006). All audio recordings were transcribed verbatim and systematically double-coded independently among two researchers (RO, PS). Following in-depth review of the coded data, independent themes were developed based on recurrent content. Both coders (RO, PS) then engaged in a cooperative discussion of themes to decide on the most pertinent and recurrent aspects of coded data. The process of refining and reviewing themes was iterative until themes were representative of the data and saturation was achieved.

**Usability**

Quantitative usability data indicated high usability scores among the participants with the average overall score of 74.16 ($SD=9.31$), exceeding the acceptable cut-off score of 68 (Sauro & Lewis, 2016). As shown in Table 1, participants felt that most people would be able to learn to use the app quickly and that they themselves felt confident using the app.

<table>
<thead>
<tr>
<th>Question</th>
<th>$M$</th>
<th>$SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Table 1</strong> Means and Standard Deviations for the SUS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
I think I would like to use the app frequently 3.50 0.55
I found the app to be unnecessarily complex 2.16 0.98
I thought the app was easy to use 3.66 1.03
I think that I would need support of a technical person to be able to use the app 1.33 0.82
I found the various functions in the app were well integrated 4.00 1.09
I thought there was too much inconsistency in the app 2.50 1.22
I would imagine that most people would learn to use the app very quickly 4.33 0.82
I found the app very cumbersome to use 2.33 0.52
I felt very confident using the app 4.17 0.75
I needed to learn a lot of things before I could get going with the app 1.66 0.82

Overall SUS Score $M = 74.16$, $SD = 9.31$

Note: Responses were scored on a 5-point Likert scale ranging from 1= Strongly disagree to 5= Strongly agree. Overall SUS score is out of 100

Acceptability

The semi-structured interviews were informed by the Enlight evaluation framework (Baumel et al., 2017). Ten open-ended questions regarding acceptability, experiences of use and challenges of utilising the app were asked to a sub-group of participants. Thematic analysis revealed seven broad themes which are described below: four themes were related to the advantages of the app and three related to the challenges.

Perceived Advantages of Minimise

**Tailored Delivery of Protective Strategies**

All participants commented that the tailored delivery of the protective strategies was useful in providing specific, alcohol-reduction information, relevant to their context. Indeed, users felt that receiving information, matched to their context, enabled the application of the strategies into their drinking context as they were applicable:

“*There were different strategies for different scenarios so there was good advice for each environment which was easy to incorporate*”

[Participant 3]

The majority of participants appreciated being prompted to use these specific strategies in the drinking context ($N=5/6$). Specifically, users reported that without the prompting reminder it would be difficult to remember to implement the strategies:
“I liked the strategies the most, using those and when it prompted you if you have intentions to drink…if I wasn’t prompted I probably would’ve forgotten”

[Participant 5]

**Habit Formation**

The users commented on how the app check-in process had become habitual. Specifically, four of the six participants experienced *Minimise* as part of their daily routine stating that it had become routine to check in with the app when they were also engaging with other apps (i.e., social media):

“We’ve become part of my app checking habit” [Participant 3]

Some participants referred to the app as having gamification elements that they felt were fun and enjoyable to complete, which provided a short distraction from reality (N=3/6). This further assisted the habit-formation of checking in with the *Minimise* app:

“It’s like having a game of bejewelled- it gives you two minutes of mindfulness” [Participant 2]

**Increased Awareness of Drinking**

A prominent finding identified among all participants was that the app increased awareness in the user in two ways; first it helped the user identify how much they were drinking and second, insight into the circumstances preceding their decision to drink.

“It made me realise that I drink more than I realised and I only drink because I am with friends. I didn’t realise that before” [Participant 5]

Three participants commented that this self-awareness was particularly effective in prompting behavioural change in regard to their alcohol consumption and would have a lasting impact on their future drinking behaviors:
“Quantity wise it's definitely going to decrease – I knew that my tolerance level was a bit low, but I used to drink anyway but now I start to see the direct effect on my health and wellbeing.”

[Participant 3]

**Insight into Current Emotional State**

Whilst it was not an intention of Minimise, four out of the six participants reported that the app had helped them to reflect on their emotions, which in turn helped to inform their decision regarding alcohol use:

“Sometimes you just don’t feel like drinking, you might be sad, but it is a mate's birthday, so you have to or a social situation where you have to. So, all those questions [in the app] helped me make the right decision.” [Participant 2]

Another user commented that the ability to monitor their emotional state helped them to understand why they were drinking:

“When I was filling in the emotions part of it every single day it made me go through a process of self-realisation - you don't often acknowledge why you drink.” [Participant 3]

**Perceived Challenges of Using Minimise**

**Technical Issues**

There were two technical issues identified by three out of six participants. First the notification schedule was inconsistent:

“Sometimes I wouldn’t even get the notification, so I then had to open the app”

[Participant 3]

Second, the slider used in the self-reports was temperamental for some items:
“Sometimes when I used to move the scale it used to get stuck. It would say this question is unanswered, but I did answer it. That used to get really annoying”

[Participant 6]

These types of errors impeded upon a small number of participants’ (N=2/6) motivation to use the app:

“The app was starting to glitch out a heap of times and I was getting really annoyed by that. I was contemplating quitting the study as I was getting sick of it”

[Participant 1]

The Strategies were not Unique

The main concern users had with the delivery of the PBS was that they were familiar with some of the strategies recommended within the app, and for some users (N=3/6), this lack of novelty reduced their engagement in the app:

“I have gone in and looked at my protective strategies a few times but a lot of them I have heard about from friends and school and so I haven’t looked over them too much” [Participant 4]

Most participants (N=4 out of 6) relied on the PBS that were novel and more specific to their situation rather than the familiar and more obvious suggestions:

“In terms of the general strategies provided like covering your drink or having a designated driver - they weren’t very specific so it wasn't that applicable”

[Participant 3]

The Lack of Certain Functions

The large proportion of users (N=5/6) commented that they would have liked more functionality surrounding the ability to track progress whilst using the app. Users emphasised that if they were able to see how many drinks they were consuming on a
frequent basis, and how this aligned with their goals, this would have better facilitated them to stay on track:

“It would be good to implement like a goal setting where people enter in their goals of how many drinks they want to have a week and then at the end of the week they can check” [Participant 1]

When asked how the strategies could be delivered in a more effective manner all users mentioned that it would be useful to include a function within the app in which the strategies that had been previously applied could be referred to at any time:

“I found it confusing because you couldn’t confirm whether or not you had used a particular strategy” [Participant 4]

Discussion

Accumulated literature suggests that PBS are a promising adjunct to treatment for risky drinking (e.g., Larimer et al., 2007). Findings have been less consistent when PBS has been offered as a stand-alone treatment (e.g., LaBrie et al., 2015). In these prior implementations, participants have typically been given strategies at a single time-point that are not tailored to their context. To expand on these developments, Minimise, an EMI for young adults that combines self-monitoring functionality and tailored delivery of protective strategies, was developed. To evaluate this app, the aim of this pilot study was two-fold; (1) assess the efficacy of Minimise using a randomised controlled trial, and (2) examine the usability and acceptability of Minimise using a qualitative study design.

Efficacy Findings

In terms of RQ1, no significant decrease in alcohol use (i.e., RSOD episodes) or drinking-related harms (i.e., interpersonal) across time or group was identified. For RQ2, participants in the intervention group significantly increased their use of PBS at follow-up, as compared to the control group.
The intervention was successful in increasing the users’ application of PBS, however, this increased uptake was not shown to be associated with a reduction in risky drinking behaviours, as would be expected. There are two possible reasons for this. First, participants may not have implemented the PBS in high-risk situations. For example, perhaps users only applied the strategies to situations in which they felt comfortable reducing their alcohol intake, where there was no expectation to drink excessively (e.g., family gathering). In contrast, in situations with inherent pressure to drink (e.g., social events with peers), participants may not have had the capability to implement the appropriate strategies. Interventions incorporating PBS should include other techniques that can support the user to overcome potential barriers in the implementation of the strategies, particularly in situations where external pressure to drink is high. Indeed, drink refusal skills training has been shown to promote self-efficacy and reductions in alcohol use, particularly in high risk social situations (e.g., Schinke, Cole & Fang, 2009; Witkiewitz, Donovan, & Hartzler, 2012). The purpose of this training is to teach the individual on how to adopt and enact more adaptive responses to social situations that involve alcohol use (Oei, Hasking, & Phillips, 2007). It would be advantageous for future app-based interventions to assess if the combination of PBS coupled with training on drink-refusal skills, generates reductions in risky drinking behaviors.

Second, it is also possible that some of the PBS strategies were not as effective as anticipated. A growing body of literature shows that there are some PBS strategy subtypes that are more effective in reducing alcohol use than others. Indeed, a number of studies (e.g., Napper, Kenney, Lac, Lewis, & LaBrie, 2014; Pearson, Kite, & Henson, 2013) have shown that strategies which change the ‘manner of drinking’ (e.g., mixing different types of alcohol) are more effective in reducing alcohol use than strategies which aim to ‘limit consumption’ (e.g., set a limit on the number of drinks) or
‘avoid serious hazards’ (e.g., nominate a designated driver). The current study used all available strategies from the PBS framework in order to deliver a breadth and variety of information, and the requirement to disseminate strategies that were tailored to the person’s context. Nonetheless, interventions utilizing PBS may benefit from delivering only the strategies that have the strongest evidence in reducing alcohol use (i.e., manner of drinking) and excluding those that are less effective (e.g., limiting consumption and avoiding serious hazards).

**Efficacy Limitations**

This pilot RCT did not include a long-term follow-up and hence it is possible that some of the changes in drinking may not be detected by the immediate post intervention assessment used. Indeed, research shows that changes to drinking behavior, via the application of PBS, can take time as the individual requires the opportunity to enact the strategy in order for a change to drinking habits to take effect (e.g., Napper, Kenney, Lac, Lewis, & LaBrie, 2014; Neighbors et al., 2012). As such, it is possible that the current intervention had a positive, delayed effect upon drinking behaviors, which would not have been discovered by the immediate-post assessment used. The current study adopted this post-intervention protocol based on prior alcohol-reduction EMIs EMIs (e.g., Dulin, Gonzalez, & Campbell, 2014; Wright et al., 2018), which use an immediate follow-up assessment to mitigate the risk of attrition and drop out. However, it is recommended that EMI studies, designed to alter habits surrounding drinking behaviors, include a longer-follow up period to ensure that if there is an intervention effect, it is captured.

The sample size of this study was small and while the power estimate suggests that it was adequate to detect moderate-large effect sizes, it would not have revealed a small effect size as significant. It is therefore recommended that future research studies, evaluating a drinking-based smartphone intervention, employ a large enough sample
that small to large significant effect sizes can be identified.

**Usability Findings**

Interestingly, even though participants did not report a reduction in their drinking, the qualitative findings were supportive of the usability and acceptability of the *Minimise* app to reduce alcohol use. In particular there were three features of the app that were well-received by the users. First, users scored *Minimise* high on the SUS due to its streamlined interface and well-integrated functionality. This feedback is important in delivering an intervention for substance misuse. Indeed, it is probable that there will be times in which the user will be engaging with the app when they are drinking and possibly intoxicated. Ensuring the system is a straightforward one is essential for people to continue to engage with the app even if they are inebriated. Second, users agreed that a strength of the *Minimise* app was its tailored functionality. In turn, participants reported that this feature made the strategies highly transferable to the environment they were in. This finding echoes a number of research studies that show tailored information is more likely to be read, remembered and acted upon, in contrast to generic information (e.g., Jacobs, Lou, Ownby, & Caballero, 2016; Yardley, Morrison, Bradbury, & Muller, 2015). Finally, participants commented that the self-monitoring functionality facilitated their understanding into how much alcohol they were drinking and the complex interplay between internal states, external factors and subsequent drinking behavior. This finding is consistent with a number of studies that have found self-monitoring useful in providing insight to and curtailing risky drinking behaviors (e.g., Freedman, Lester, McNamara, Milby, & Schumacher, 2006; Scott, Dennis, & Gustafson, 2017).

**Usability Limitations**

Notwithstanding the positive feedback regarding *Minimise*, qualitative feedback identified two key areas in which the app could be improved. First, some participants
were already familiar with the strategies suggested by the app and were hoping instead to find new approaches to reducing their drinking. When they recognised strategies, they reported being less interested and engaged in the app. Further instruction at the outset of the study that the app provides common sense, easy-to-implement approaches that may be familiar to the user, may serve to offset expectation that all the strategies will be novel and unfamiliar to the participants. A second limitation was the lack of advanced goal-setting functionality. While the self-monitoring component of Minimise was designed to facilitate monitoring and tracking of performance, more explicit messaging and prompts to remind participants of their goals (especially when they are struggling to maintain these) may be helpful. Indeed, research suggests the mere reminder of goals can be enough to keep participants on track with their intended behavior change (Fry, Drennan, Previte, White, & Tjondronegoro, 2014; Ryan, Patrick, Deci, & Williams, 2008).

Implications and Conclusion

There are a number of implications that warrant consideration. First, the lack of efficacy findings suggest that more work is needed on the specific intervention content that is delivered within this app. More broadly, this finding suggests that PBS delivered as a standalone intervention, repetitively and tailored to the user’s goal and context, does not appear to be an effective method to reduce risky drinking behaviors among young adults, at least not in the short term. Future smartphone-based research that includes PBS components should pair this with additional intervention components that have a strong evidence base (e.g., implementation intentions [e.g., Gollwitzer & Sheeran, 2006]; normative feedback [e.g., Doumas & Andersen 2009]; and drink-refusal skills training [e.g., Witkiewitz, Donovan, & Hartzler, 2012]).

Second, the results of the qualitative study demonstrate Minimise as a highly usable and acceptable tool in helping young adults reduce their alcohol consumption
and drinking related harm in their everyday life. This finding suggests smartphone apps as a viable mechanism that researchers and health professionals can use to deliver drinking-based interventions. This is especially important for those working with young people, considering how notoriously difficult they are to engage in AoD programs (Rickwood et al., 2007), but yet how frequently they engage with their smartphone device (Dennison et al., 2013).

In conclusion, this study found that users of the Minimise app significantly increased their application of PBS. Moreover, the app itself was rated by end-users as a highly acceptable and usable device to intervene on drinking behaviors. Despite these encouraging findings, Minimise did not effectively change drinking-related outcomes among young adults. This suggests one of two things; first, the Minimise app was ineffective in reducing the user’s drinking behaviors. Given the usability assessment revealed the app to be user-friendly, it is possible that the limited feature of the app is the intervention used, the PBS. As research findings suggest, PBS is more effective when delivered as part of a multicomponent intervention. Further work is needed to examine if a smartphone app that delivers PBS, coupled with other effective intervention components, can generate a reduction in the user’s risky drinking behaviors. The second possibility is that the effect of the intervention was delayed and in turn, not captured by the immediate follow-up assessment used. Further work is needed to verify these findings. With the significant potential that smartphone-based drinking interventions provide young people (i.e., accessibility, ease of use, no shame), it is important we as researchers invest in developing a smartphone app that can effectively reduce harmful drinking-behaviors among young people.
References


Sauro, J., & Lewis, J. R. (2016). *Quantifying the user experience: Practical statistics for user research*. Morgan Kaufmann.


Wright, C., Dietze, P. M., Agius, P. A., Kuntsche, E., Livingston, M., Black, O. C., … Lim, M. S. (2018). Mobile Phone-Based Ecological Momentary Interventions to Reduce Young Adults’ Alcohol Use in the Event: A Three-Armed Randomized Controlled Trial. *JMIR mHealth and uHealth, 6*(7), e149.


Appendix 5.1

Images of Minimise

*Figure 1.*
Goal-Setting for Minimise

*Figure 2.*
General Strategies Provided by Minimise
Feedback of Alcohol Use and Strategy Use

<table>
<thead>
<tr>
<th>Total reported drinking days</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategies used</td>
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</tr>
<tr>
<td>Strategies not used</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Percentage of drinking days with risky drinking</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategies used</td>
<td>0.00</td>
</tr>
<tr>
<td>Strategies not used</td>
<td>0.00</td>
</tr>
<tr>
<td>Total</td>
<td>0.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Percentage of drinking days with negative consequences</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategies used</td>
<td>0.00</td>
</tr>
</tbody>
</table>

*Figure 3.* Feedback of Alcohol Use and Strategy Use
Images of *InstantSurvey*

*Figure 1.* Self-Monitoring within *InstantSurvey*

*Figure 2.* Self-Monitoring within *InstantSurvey*
Appendix 5.3
Algorithm to Inform the delivery of PBS within Minimise

Please note that some of the protective behavioural strategies have the same tags so the delivery of the strategies were randomised to ensure participants were offered different options.

PBS delivered: Set a drink limit
If the following tags were selected;
- Social Context: Being with other people
- Social Context: Alone
- Affect: Negative Mood
- Goal: Reduce alcohol consumption
- Goal: Reduce alcohol consequences

PBS delivered: Alternate alcoholic and non-alcoholic drinks
If the following tags were selected;
- Social Context: Being with other people
- Social Context: Alone
- Goal: Reduce alcohol consumption
- Goal: Reduce alcohol consequences
- Affect: Negative Mood

PBS delivered: Predetermine your leaving time
If the following tags were selected;
- Social Context: Being with other people
- Goal: Reduce alcohol consumption
- Goal: Reduce alcohol consequences
- Affect: Negative Mood

PBS delivered: Have a friend let you know when you have had enough
If the following tags were selected;
- Social Context: Being with other people
- Goal: Reduce alcohol consumption
- Goal: Reduce alcohol consequences
- Affect: Negative Mood

PBS delivered: Put extra ice in your drink
If the following tags were selected;
- Social Context: Being with other people
- Social Context: Alone
- Goal: Reduce alcohol consumption
- Goal: Reduce alcohol consequences
- Affect: Negative Mood

PBS delivered: Avoid drinking games
If the following tags were selected;
- Social Context: Being with other people
• Social Context: Alone
• Goal: Reduce alcohol consumption
• Goal: Reduce alcohol consequences
• Affect: Negative Mood

PBS delivered: Avoid drinking on an empty stomach*
*If the following tags were selected;
• Social Context: Being with other people
• Social Context: Alone
• Goal: Reduce alcohol consumption
• Goal: Reduce alcohol consequences
• Affect: Negative Mood

PBS delivered: No shots
*If the following tags were selected;
• Social Context: Being with other people
• Social Context: Alone
• Goal: Reduce alcohol consumption
• Goal: Reduce alcohol consequences
• Affect: Negative Mood

PBS delivered: Avoid mixing different types of alcohol
*If the following tags were selected;
• Social Context: Being with other people
• Social Context: Alone
• Goal: Reduce alcohol consumption
• Goal: Reduce alcohol consequences
• Affect: Negative Mood

PBS delivered: Don't try to keep up with others
*If the following tags were selected;
• Social Context: Being with other people
• Social Context: Alone
• Goal: Reduce alcohol consumption
• Goal: Reduce alcohol consequences
• Affect: Negative Mood

PBS delivered: Use a designated driver
*If the following tags were selected;
• Social Context: Being with other people
• Goal: Reduce alcohol consequences
• Affect: Negative Mood
• Affect: Positive Mood

PBS delivered: Have a friend look out for you*
*If the following tags were selected;
• Social Context: Being with other people
• Goal: Reduce alcohol consumption
• Goal: Reduce alcohol consequences
• Affect: Negative Mood

**PBS delivered: Know where your drink has been at all times**
*If the following tags were selected:*
  • Social Context: Being with other people
  • Goal: Reduce alcohol consequences
  • Affect: Negative Mood

**PBS delivered: Write your own reminder that will help you stick to a drinking limit***
*If the following tags were selected:*
  • Social Context: Being with other people
  • Social Context: Alone
  • Goal: Reduce alcohol consumption
  • Goal: Reduce alcohol consequences
  • Affect: Negative Mood

**PBS delivered: Plan a response for not drinking early in advance***
*If the following tags were selected:*
  • Social Context: Being with other people
  • Goal: Reduce alcohol consumption
  • Goal: Reduce alcohol consequences
  • Affect: Negative Mood

**PBS delivered: Set a spending limit***
*If the following tags were selected:*
  • Social Context: Being with other people
  • Social Context: Alone
  • Goal: Reduce alcohol consumption
  • Goal: Reduce alcohol consequences
  • Affect: Negative Mood

**PBS delivered: Avoid situations in which heavy drinking is likely***
*If the following tags were selected:*
  • Social Context: Being with other people
  • Goal: Reduce alcohol consumption
  • Goal: Reduce alcohol consequences
  • Affect: Negative Mood

**PBS delivered: Be mindful and aware of internal body reactions that indicate you are intoxicated***
*If the following tags were selected:*
  • Social Context: Being with other people
  • Social Context: Alone
  • Goal: Reduce alcohol consequences
  • Affect: Negative Mood

**PBS delivered: Drink light beer compared to full strength beer***
*If the following tags were selected:*


• Social Context: Being with other people
• Social Context: Alone
• Goal: Reduce alcohol consequences
• Affect: Negative Mood

**PBS delivered: Drink light beer compared to full strength beer***

*If the following tags were selected;*
• Social Context: Being with other people
• Social Context: Alone
• Goal: Reduce alcohol consequences
• Goal: Reduce alcohol consumption

**PBS delivered: Engage in activities while drinking to space your drinks out***

*If the following tags were selected;*
• Social Context: Being with other people
• Social Context: Alone
• Goal: Reduce alcohol consequences
• Goal: Reduce alcohol consumption
• Affect: Negative Mood

**PBS delivered: Plan activities other than drinking to improve your mood (e.g., seeing friends)**

*If the following tags were selected;*
• Social Context: Alone
• Goal: Reduce alcohol consequences
• Goal: Reduce alcohol consumption
• Affect: Negative Mood

*Refers to strategies that were developed for this study*
### Table 1.
Pattern of Missing Values

<table>
<thead>
<tr>
<th></th>
<th>RSOD T1</th>
<th>RSOD T2</th>
<th>Work Study T1</th>
<th>Work Study T2</th>
<th>Interpersonal T1</th>
<th>Interpersonal T2</th>
<th>Physically Unwell T1</th>
<th>Physically Unwell T2</th>
<th>PBS Alcohol T1</th>
<th>PBS Alcohol T2</th>
<th>PBS Harm T1</th>
<th>PBS Harm T2</th>
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<tr>
<td>n</td>
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<td>7</td>
<td>1</td>
<td>7</td>
<td>1</td>
<td>7</td>
<td>0</td>
<td>7</td>
<td>0</td>
<td>7</td>
<td>0</td>
<td>7</td>
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</table>

*Note. n refers to the number of people who did not respond to the assessment*
# Appendix 5.5
CONSORT Checklist

## CONSORT 2010 checklist of information to include when reporting a randomised trial*

<table>
<thead>
<tr>
<th>Section/Topic</th>
<th>Item No</th>
<th>Checklist item</th>
<th>Reported on page No</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title and abstract</strong></td>
<td>1a</td>
<td>Identification as a randomised trial in the title</td>
<td>139</td>
</tr>
<tr>
<td></td>
<td>1b</td>
<td>Structured summary of trial design, methods, results, and conclusions <em>(for specific guidance see CONSORT for abstracts)</em></td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Introduction</strong></td>
<td>2a</td>
<td>Scientific background and explanation of rationale</td>
<td>139-140</td>
</tr>
<tr>
<td><strong>Background and objectives</strong></td>
<td>2b</td>
<td>Specific objectives or hypotheses</td>
<td>143-144</td>
</tr>
<tr>
<td><strong>Methods</strong></td>
<td>3a</td>
<td>Description of trial design <em>(such as parallel, factorial) including allocation ratio</em></td>
<td>144</td>
</tr>
<tr>
<td></td>
<td>3b</td>
<td>Important changes to methods after trial commencement *(such as eligibility criteria), with reasons</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Participants</strong></td>
<td>4a</td>
<td>Eligibility criteria for participants</td>
<td>145</td>
</tr>
<tr>
<td></td>
<td>4b</td>
<td>Settings and locations where the data were collected</td>
<td>146-147</td>
</tr>
<tr>
<td><strong>Interventions</strong></td>
<td>5</td>
<td>The interventions for each group with sufficient details to allow replication, including how and when they were actually administered</td>
<td>146-148</td>
</tr>
<tr>
<td><strong>Outcomes</strong></td>
<td>6a</td>
<td>Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed</td>
<td>148-149</td>
</tr>
<tr>
<td></td>
<td>6b</td>
<td>Any changes to trial outcomes after the trial commenced, with reasons</td>
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</tr>
<tr>
<td><strong>Sample size</strong></td>
<td>7a</td>
<td>How sample size was determined</td>
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<tr>
<td></td>
<td>7b</td>
<td>When applicable, explanation of any interim analyses and stopping guidelines</td>
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</tr>
<tr>
<td><strong>Randomisation:</strong></td>
<td>8a</td>
<td>Method used to generate the random allocation sequence</td>
<td>144-145</td>
</tr>
<tr>
<td><strong>Sequence generation</strong></td>
<td>8b</td>
<td>Type of randomisation; details of any restriction <em>(such as blocking and block size)</em></td>
<td>144-145</td>
</tr>
<tr>
<td>Allocation concealment mechanism</td>
<td>9</td>
<td>Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned</td>
<td>144-145</td>
</tr>
<tr>
<td>Implementation</td>
<td>10</td>
<td>Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions</td>
<td>144-145</td>
</tr>
<tr>
<td>Blinding</td>
<td>11a</td>
<td>If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how</td>
<td>144-145</td>
</tr>
<tr>
<td></td>
<td>11b</td>
<td>If relevant, description of the similarity of interventions</td>
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<tr>
<td>Statistical methods</td>
<td>12a</td>
<td>Statistical methods used to compare groups for primary and secondary outcomes</td>
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</tr>
<tr>
<td></td>
<td>12b</td>
<td>Methods for additional analyses, such as subgroup analyses and adjusted analyses</td>
<td>149</td>
</tr>
<tr>
<td>Results</td>
<td>Participant flow (a diagram is strongly recommended)</td>
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<td>For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome</td>
</tr>
<tr>
<td></td>
<td>13b</td>
<td>For each group, losses and exclusions after randomisation, together with reasons</td>
<td>145</td>
</tr>
<tr>
<td>Recruitment</td>
<td>14a</td>
<td>Dates defining the periods of recruitment and follow-up</td>
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<tr>
<td></td>
<td>14b</td>
<td>Why the trial ended or was stopped</td>
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</tr>
<tr>
<td>Baseline data</td>
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<td>A table showing baseline demographic and clinical characteristics for each group</td>
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</tr>
<tr>
<td>Numbers analysed</td>
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<td>For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups</td>
<td>153</td>
</tr>
<tr>
<td>Outcomes and estimation</td>
<td>17a</td>
<td>For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)</td>
<td>154</td>
</tr>
<tr>
<td></td>
<td>17b</td>
<td>For binary outcomes, presentation of both absolute and relative effect sizes is recommended</td>
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</tr>
<tr>
<td>Ancillary analyses</td>
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<td>Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory</td>
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</tr>
<tr>
<td>Harms</td>
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</tr>
<tr>
<td>Discussion</td>
<td>Limitations</td>
<td>20</td>
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</tr>
<tr>
<td>Generalisability</td>
<td>21</td>
<td>Generalisability (external validity, applicability) of the trial findings</td>
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<tr>
<td>Interpretation</td>
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<td>Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence</td>
<td>163</td>
</tr>
<tr>
<td>Other information</td>
<td>Registration</td>
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<td>Registration number and name of trial registry</td>
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<tr>
<td>Protocol</td>
<td>24</td>
<td>Where the full trial protocol can be accessed, if available</td>
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</table>
Appendix 5.6  
Supplementary Graphs for the Main Analyses

Figure 1.  
Comparison and Intervention Pre and Post for RSOD Episodes with 95% Confidence Intervals

Figure 2.  
Comparison and Intervention Pre and Post for Work/Study Consequences with 95% Confidence Intervals
Figure 3.
Comparison and Intervention by Pre and Post for Interpersonal Consequences with 95% Confidence Intervals

Figure 4.
Comparison and Intervention by Pre and Post for being Unwell with 95% Confidence Intervals
Figure 5.
Comparison and Intervention by Pre and Post for Using PBS for Alcohol Use with 95% Confidence Intervals

Figure 6.
Comparison and Intervention by Pre and Post for Using PBS for Alcohol Harm with 95% Confidence Intervals
Appendix 5.7

Ethics Approval for Empirical Study Two

Memorandum

To: Dr Ben Richardson
   School of Psychology

B

From: Deakin University Human Research Ethics Committee (DUHREC)

Date: 26 April, 2016

Subject: 2016-059

A pilot evaluation of a smartphone-based program to reduce harm associated with risky drinking

Please quote this project number in all future communications

The application for this project was considered at the DU-HREC meeting held on 21/03/2016.

Approval has been given for Dr Ben Richardson, School of Psychology, to undertake this project from 26/04/2016 to 26/04/2020.

The approval given by the Deakin University Human Research Ethics Committee is given only for the project and for the period as stated in the approval. It is your responsibility to contact the Human Research Ethics Unit immediately should any of the following occur:

- Serious or unexpected adverse effects on the participants
- Any proposed changes in the protocol, including extensions of time.
- Any events which might affect the continuing ethical acceptability of the project.
- The project is discontinued before the expected date of completion.
- Modifications are requested by other HRECs.

In addition you will be required to report on the progress of your project at least once every year and at the conclusion of the project. Failure to report as required will result in suspension of your approval to proceed with the project.

DUHREC may need to audit this project as part of the requirements for monitoring set out in the National Statement on Ethical Conduct in Human Research (2007).

Human Research Ethics Unit
research-ethics@deakin.edu.au
Telephone: 03 9251 7123
Appendix 5.8
Manuscript Submitted to International Journal of Behavioral Medicine

Abstract

Background: To date, no research has evaluated the efficacy of smartphone interventions designed to deliver personalised harm minimisation strategies to reduce alcohol use. The current pilot study, therefore, evaluated the efficacy and usability of a newly developed smartphone app for young adults motivated to reduce their alcohol use.

Methods: Efficacy was assessed using a single-blind, randomised controlled trial in which 45 young adults were randomly assigned to either the intervention app (n=25; 18 females; $M_{age}=21.36$ years, $SD_{age}=4.15$ years) or control app (n=20; 18 females; $M_{age}=22.75$; $SD_{age}=4.41$). Primary outcomes included frequency of risky drinking and drinking-related harms, while the secondary outcome examined the frequency of using Protective Behavioral Strategies (PBS) in drinking contexts. All outcomes were measured at baseline and immediately post-intervention. Using the Enlight framework [1], usability was evaluated via structured one-on-one phone interviews with a subgroup of six participants from the intervention group (3 females; $M_{age}=19.5$ years, $SD_{age}=1.64$).

Results: There was no significant reduction in the primary outcomes from baseline to post-intervention across the groups. For the secondary outcomes, the application of PBS within drinking contexts significantly increased at follow-up, in the intervention group only. Although end-users rated the app as highly usable, some concerns with repetition of the strategies were noted.

Conclusions: This intervention, designed to reduce risky drinking behaviors among young adults, was rated as highly usable and was shown to increase the application of harm minimization strategies within drinking contexts. While the intervention and its
delivery show promise, it did not mitigate risky drinking behaviours. Implications of this research and future directions are discussed.

This trial is registered at Australia and New Zealand Clinical Trials Register: BLINDED
Overview

Traditionally, alcohol-reduction interventions available to young adults include Motivational Interviewing (MI) or Cognitive Behavioral Therapy (CBT), which aim to modify cognitions regarding alcohol use and are delivered by a therapist in a health care service setting [e.g., 2]. However, as the findings from recent Ecological Momentary Assessment (EMA) studies show, the strongest predictors of young adults’ drinking behaviors are not stable factors (i.e., dispositional drinking motivations), but rather dynamic factors within the drinking context (i.e., social interpersonal factors) [3, 4]. Given these risk factors occur within the drinking context (rather than just within the person), intervention is required that extends beyond the standard treatment context (e.g., therapist office) and offers real-time support during the moments when the risk factors are present. A further limiting feature of these traditional forms of alcohol interventions is that the young person is required to initiate professional help in primary and secondary health care settings. Young people experiencing drinking-related problems underutilise professional treatment for a variety of reasons (e.g., shame, financial reasons, geographical barriers, etc.) [e.g., 5, 6]. Finding useful, accessible and confidential ways to reduce risky drinking among young people remains a key research and health priority.

This pilot study reports on the evaluation of a smartphone-delivered intervention that targets situation-specific risk factors which are known to precipitate young adults’ risky drinking. The evaluation of the intervention occurred in two parts as per guidelines described by the Medical Research Council [7]; (1) using a randomised controlled trial, the efficacy of the intervention was examined, and (2) employing a qualitative study design, the usability and acceptability of the intervention was evaluated.

Protective Behavioral Strategies
One approach that has shown promise when used as part of a multi-component alcohol-reduction intervention is Protective Behavioral Strategies (PBS); simple behavioral techniques designed to reduce drinking and/or drinking-associated harm such as drink driving [8]. PBS [8] may be separated into three subtypes: stopping or limiting consumption (e.g., setting drinking limits), changing the manner of drinking (e.g., avoiding drinking games, drinking beer instead of spirits), and avoiding serious hazards associated with drinking (e.g., organizing a designated driver).

**Evidence for Protective Behavioral Strategies**

Cross-sectional evidence suggests that individuals who participate in interventions employing PBS as well as other components (e.g., personalised feedback regarding drinking levels, information on drinking-consequences), are less inclined to drink in a risky manner [9, 10]. For example, a recent study [11] found that participants who were provided with a multi-component brief intervention that included personalised feedback, enhancement of motivation, goal development, and PBS, meaningfully reduced the number of heavy drinking days (in the prior 30 days), three months after the intervention ($M=2.56$ heavy drinking days, $SD=3.26$) as compared to baseline ($M=3.05$ heavy drinking, $SD=4.05$). Focused evaluations of PBS have also shown it to be an effective mediator within multicompontent interventions [e.g., 12, 13].

Despite PBS showing promise within multicomponent intervention contexts, when delivered as a standalone intervention (without other intervention components), it is not as effective (14, 15). For example, a recent study [14] found that 1-month post-intervention, participants who had received the PBS intervention showed no meaningful difference in the maximum number of drinks they had consumed on a single occasion in the prior 30 days ($M=7.25$ number of drinks, $SD=3.93$) compared to a control group ($M=7.91$ number of drinks, $SD=4.09$).
Two reasons may account for these weak findings regarding the application of PBS as a stand-alone intervention. First, a single delivery of PBS at one point in time is unlikely to be sufficient to facilitate sustained change in an individual’s drinking habits. Rather, repetition and consistent reminders of these strategies may better facilitate behavior change [16, 17]. Second, these psychoeducational interventions did not tailor the provision of PBS to the individual’s drinking context, their momentary affective state or the types of drinking-based goals they wanted to achieve (e.g., reduction in consumption or drinking-related consequences).

Factors to Inform Drinking Interventions

Recent EMA studies [3, 4] have shown momentary affect and social interpersonal factors within the drinking context as significant determinants of young adults’ drinking behaviors. Dvorak and colleagues found daily negative affect predictive of subsequent heavy drinking, whereas daily positive affect was predictive of drinking-related harm. Thus, whether the valence of affect is negative or positive may have important implications for either heavy drinking or drinking-related harm. In terms of the social interpersonal context, Kuntsche and colleagues found young adults who experienced social situations marked by interactions with same-sex friends at drinking establishments, as more likely to drink in a risky manner, compared to when they were not exposed to these types of situations. Finally, health behavior change interventions are enhanced with the inclusion of goal-setting. Indeed, there is a significant body of research that supports the applicability and utility of goal-setting within alcohol behavior change [18, 19]. As such, implementation of PBS interventions should be sufficiently flexible to tailor messages and strategies to individuals’ momentary affect, social drinking context, and drinking-related goal.

Ecological Momentary Intervention
Ecological Momentary Intervention (EMI) is defined as a method to intervene upon behavior in the moment [20] via a mobile device. EMI enables the delivery of a PBS-based intervention tailored to individuals’ affective state, social context, and their drinking-related goal. This in-the-moment modality offers many advantages over traditional intervention formats (e.g., therapist delivered), including: (a) EMIs can use EMA data to provide support that is personalised and tailored to the individual’s context [21] and; (b) Using “decision rules”, EMI can deliver information in a timely manner close to the target behavior [e.g., 22], which is more effective than delayed interventions [e.g., 23].

**Current Study**

The EMI framework provides a number of strengths in delivering alcohol reduction interventions. Though as yet, an EMI that delivers PBS that are tailored to an individual’s goals and drinking context, in the moment, has not been trialled. To address this, *Minimise* was developed by our research team to deliver a range of PBS over a sustained period of time (28 days), tailored to the user’s drinking goal (i.e., reduce alcohol and/or drinking-related consequences), their momentary affective state (i.e., negative or positive) and their social, interpersonal context (i.e., who they are with). The principal part of this pilot study (Part One) is to assess the efficacy of this intervention using a randomised controlled trial. The specific Research Questions (RQs) of this component of the study include;

RQ1: To what extent do individuals who receive *Minimise* report a reduction in the two primary outcomes of frequency of Risky Single Occasion Drinking (RSOD, five or more Standard Drinks consumed in a single setting) and alcohol-related harms (e.g., interpersonal disputes) compared to individuals in the control group?
RQ2: To what extent do individuals who receive the Minimise app exhibit an increase in the secondary outcome of frequency of PBS use in comparison to those in the control group?

The secondary aim of this study (Part Two) is to explore the usability and acceptability of the Minimise application. In particular, the objective of this component of the study includes;

RQ3: To what extent do users of Minimise perceive the app as a usable device to facilitate reductions in risky drinking behaviours?

RQ4: To what extent do users of Minimise perceive the app as an acceptable device to reduce risky drinking behaviours?

Part One Efficacy
Method
Trial Design
To examine preliminary efficacy of Minimise (RQ1 and RQ2), a single-blind, randomised controlled trial using a two-arm parallel sequence in which the primary outcomes (drinking behaviors) and secondary outcomes (PBS use) were measured at baseline and immediately post the intervention. This study was approved by the authors’ Ethics Committee board, and all procedures were in accordance with the National Health and Medical Research Council [7]. Refer to Electronic Supplementary Material 1.5 for Consolidated Standards of Reporting Trials Checklist.

Randomisation and Blinding
Following screening and completion of the baseline questionnaire, eligible participants were randomly assigned to the intervention or control group using a pre-determined computerised sequence by Qualtrics (www.qualtrics.com). At the end of the baseline questionnaire, the presentation of the app-download instructions was randomized, alternating between how to download the self-monitoring ‘InstantSurvey’ smartphone app [24] or the intervention, ‘Minimise’ app. Participants were fully blinded
as to which group they were assigned to (i.e., they did not know which app corresponded to the intervention or control group). Once participants had completed the follow-up assessment (immediately post the intervention period), they were informed as to which group they were in and debriefed. Those in the control group were offered the intervention app (Minimise) after the debrief.

**Study Population**

Participants were recruited via invitations on social media (e.g., Facebook), and from advertisements placed within a large metropolitan university campus. Participants were eligible for the trial if they answered yes to the following criteria in the baseline survey; (a) aged 18-35 years; (b) access to an iPhone; (c) reported being motivated to reduce alcohol use and; (d) consume alcohol, on average, at least once a week.

**Participants**

**Intervention**

A total of 25 individuals aged between 18 and 35 years (18 females; $M_{\text{age}}=21.36$ years, $SD_{\text{age}}=4.15$ years) completed the baseline assessment and were randomized to download the *Minimise* app (see Fig 1). After downloading the app, three participants were lost to follow-up. This reduced the sample of participants who completed all phases of the intervention study (i.e., baseline and follow-up) to 22.

**Control**

A total of 20 individuals aged between 18 and 32 years (18 females; $M_{\text{age}}=22.75$; $SD_{\text{age}}=4.41$) completed the baseline assessment and were randomized to download the *InstantSurvey* app (see Fig 1). After downloading the app, four participants were lost to follow-up. This reduced the sample of participants who completed all phases of the control study (i.e., baseline and follow-up) to 16.
Intervention App

*Minimise*, a smartphone app developed by the authors, delivers PBS that are tailored to the users’ goals and drinking context. On first use, *Minimise* will ask the user which goals they want to achieve from the app; (a) reduce the amount of alcohol they consume and/or (b) reduce their experience of adverse drinking-related consequences (see Electronic Supplementary Material 1.1, Figure 1). Once the goals are selected this information is stored in the app and informs the algorithm of PBS delivery (detailed below). Following this, the user receives two messages per day, once at 11:00am and
again at 8:00pm, for 28 consecutive days. These messages ask the user to complete a short self-monitoring survey which examines; (a) drinking behaviors: current drinking intention (i.e., do you intend to drink today?), if alcohol had been consumed since the last assessment and if so how much (on a 1-10 scale), if the user has experienced adverse drinking-related consequences (i.e., work/study, unwell, interpersonal difficulties); (b) drinking context: social interpersonal context (i.e., are you with other people or alone?), positive affect (i.e., do you feel happy?) and negative affect (i.e., do you feel stressed?) and; (c) PBS use for alcohol consumption (i.e., did you use a strategy to manage your alcohol use?) and drinking-related harm (i.e., did you use a strategy to manage drinking-related harm?)

During this short self-monitoring survey, if the user indicates that they are drinking or that they intend to drink they immediately receive a message alerting them to “please review your strategies”, which is located under the ‘strategies’ tab within the app (see Electronic Supplementary Material 1.1, Figure 2). Three strategies are delivered within the app and tailored to the users’; (i) goals (i.e., to reduce alcohol use and/or alcohol harm), (ii) current affect (i.e., positive or negative affect), and (iii) social context (i.e., alone or with other people; refer to Electronic Supplementary Material 1.3 to view algorithm in detail). While Minimise includes a total of 21 different PBS built into the app, only three PBS were delivered per drinking event. Of the 21 strategies embedded within Minimise, 11 were derived from the PBS Scale [8], while 10 strategies were developed for this study (Electronic Supplementary Material 1.3). In addition, Minimise allows the user to access their drinking statistics at any time (including percentage of days of PBS use, percentage of days of risky drinking etc.; refer to Electronic Supplementary Material 1.1, Figure 3).

Control App
*InstantSurvey* is a smartphone application that comprises alcohol self-monitoring functions (see Electronic Supplementary Material 1.2 for screenshots of these functions). Similar to *Minimise*, the app delivers two messages per day, once at 11:00 am and again at 8:00 pm, for 28 consecutive days. This message asks the user to complete a short self-monitoring survey which examines similar items as the *Minimise* app (i.e., drinking behaviors and drinking context). The *InstantSurvey* app does not provide any information regarding PBS.

**Measures**

Using an online survey, the following was assessed at baseline; basic demographics (i.e., age and gender), the Alcohol Use Disorders Identification Test (AUDIT), primary and secondary outcomes. Immediately post the intervention, the primary and secondary outcomes were reassessed.

The AUDIT was used to identify the level of drinking-related problems exhibited by the sample at baseline [25]. The AUDIT is a 10-item questionnaire that examines consumption, dependence, and drinking-related problems ($\alpha = 0.79$). Items 1 to 8 are scored on a 5-point rating scale ($0 = never, 5 = daily$) and questions 9 to 10 are scored on a 3-point rating scale ($0 = no, 2 = yes, in the past year$). Research indicates that AUDIT scores from 8 to 15 represent a moderate level of risky drinking, with scores above 15 being representative of more problematic use [26].

**Primary Outcome**

To assess the primary outcomes regarding the frequency of RSOD and drinking-related harms, the following questions were asked: ‘*over the past two weeks how many times did you;* (a) consume more than four Australian Standard Drinks (ASDs; 10 g ethanol); (b) experience difficulties with work and/or study due to your drinking (RSOD); (c) experience interpersonal difficulties due to your drinking; and (d) felt
physically unwell due to your drinking. Items were scored on a 4-point rating scale (0=never, 1 = 1-2 times, 2 = 3-4 times, 3= more than 4 times).

**Secondary Outcome**

To assess the secondary outcomes regarding the frequency of applying PBS, participants were asked, ‘over the past two weeks how many times did you…’: (a) use a PBS to control the amount of alcohol you drank (PBS alcohol), and; (b) use a PBS to reduce harm when drinking (PBS harm). Items were scored on a 4-point rating scale (0=never, 1 = 1-2 times, 2 = 3-4 times, 3= more than 4 times).

**Results**

**Data Analytic Procedure**

For the preliminary analyses, independent sample t tests were employed to determine if there were differences in the baseline characteristics of age and AUDIT total score and a Pearson’s chi-square was used to assess if there were differences in the gender proportions between the groups (i.e., intervention and control). For the main analysis, mixed-effect models were used assess the influence of time, group and interaction of time * group on the primary and secondary outcomes. In each model, intercept and time were included as random effects and group was modelled as a fixed effect. Furthermore, a Poisson distribution was used in these mixed models given the outcomes were measured as count variables (e.g., frequency of risky drinking in the prior two weeks).

Missing values were evident at follow-up for both the primary and secondary outcome variables (see Electronic Supplementary Material 1.4 for more information). Little’s Missing Completely at Random test revealed the data across each of the outcomes was missing completely at random; $\chi^2 (2, \text{N}=45) = 6.09, p = .99$. Therefore, all available data were used in the main analyses using maximum likelihood estimation. Analyses were performed using Mplus [27].
Adherence Statistics

Adherence with the app was calculated as the percentage of days the individual was engaged with the app, out of the possible 28. For the intervention group, a total of 25 participants responded to 953 prompts, out of a possible 1,400 prompts (68%) across 552 days (out of a possible 700). On average, participants in the intervention group engaged with the app on 22.08 days ($SD=9.70$) out of a possible 28, giving an adherence rate of 79%. Participants in the intervention group provided close to two reports per day ($M=1.72$; $SD=0.63$) out of two. Preliminary analyses were conducted to evaluate whether adherence (i.e., total number of days responded to the app) was influenced by age and gender, and whether adherence was associated with a difference in outcomes at follow-up. The results found adherence to the Minimise app was unrelated to age ($r=.20$, $p=.40$) and gender ($r=.24$, $p=.30$). Furthermore, adherence to Minimise was not significantly related to changes in any of the outcomes at follow-up (RSOD, $r=.14$, $p=.56$; Work Difficulties, $r=-.12$, $p=.61$; Interpersonal, $r=-.25$, $p=.28$; Unwell, $r=.01$, $p=.96$; PBS Alcohol Use, $r=.02$, $p=.94$; PBS Harm, $r=-.16$, $p=.48$). This suggests that there was no difference in outcomes at follow-up for those who engaged in Minimise more so than others.

The 20 participants in the control group responded to 906 prompts (out of a possible 1,120; 81%), across 442 days of self-monitoring (out of 560). On average, participants in the control group reported a response on 22.1 days out of 28 ($SD=8.55$), giving an adherence rate of 79%. Participants in the control group were providing close to two self-reports each day ($M=1.96$, $SD=0.50$) out of two. In terms of the relationship between adherence and demographics, the findings revealed that adherence was not significantly related to gender ($r=.37$, $p=.17$), though was negatively correlated with age ($r=-.56$, $p=.03$), suggesting that older participants engaged with the app less than younger participants. Furthermore, results found that adherence to InstantSurvey was
negatively correlated with changes at follow-up in the outcome of being unwell due to drinking ($r = -0.57\ p = .03$) and the frequency of PBS use for alcohol consumption ($r = -0.56\ p = .03$). There was no significant association between adherence and change in the other outcomes at follow-up (RSOD, $r = -0.29,\ p = .29$; Work Difficulties, $r = -0.31,\ p = .26$; Interpersonal, $r = -0.03,\ p = .91$; PBS Harm, $r = -0.32,\ p = .25$).

**Preliminary Analysis**

Preliminary analyses were conducted to evaluate if there were significant differences observed across the groups for the baseline characteristics including; age, gender and AUDIT total score (as shown in Table 1). There were no significant differences between the groups for these demographic and alcohol-related measures.

**Table 1.** Comparison of Demographic and Baseline Alcohol-Related Variables by Group

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Intervention</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age – Mean (SD)</td>
<td>22.75 (4.41)</td>
<td>21.36 (4.15)</td>
<td>$t(43) = 1.09$</td>
</tr>
<tr>
<td>Gender – % (n)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>90% (18)</td>
<td>72% (18)</td>
<td>$\chi^2 (1) = 2.25$</td>
</tr>
<tr>
<td>Male</td>
<td>10% (2)</td>
<td>28% (7)</td>
<td></td>
</tr>
<tr>
<td>AUDIT– Mean (SD)</td>
<td>14.10 (6.30)</td>
<td>11.48 (3.55)</td>
<td>$t(28) = 1.66$</td>
</tr>
</tbody>
</table>

**Main Analysis**

*Mean Differences Between Group and Time for Primary and Secondary Outcomes*

Sample means for the primary (i.e., RSOD and drinking-related harm) and secondary outcomes (i.e., PBS use for alcohol consumption and harm) at baseline and follow-up, across the groups (intervention and control), are presented in Table 2. There were no significant differences at baseline in the primary or secondary outcomes across the intervention or control, suggesting that at baseline, the groups were similar to each other. At follow-up, there was no significant change in the primary outcomes across the groups. Whereas, for the secondary outcomes, participants in the intervention group were shown to endorse PBS for alcohol use ($M=1.61,\ SD=.17$) and harm ($M=1.47,\ SD=.22$) significantly
more than those in the control group ($M=1.07, SD=.20; M=0.63, SD=.25$, respectively) at follow-up.
## Table 2. Frequency of Primary and Secondary Outcomes in the Prior Two Weeks Across Group and Time

<table>
<thead>
<tr>
<th>Time Group</th>
<th>T1 Control (n=20)</th>
<th>T2 Control (n=16)</th>
<th>T1 vs T2</th>
<th>T1 Intervention (n=25)</th>
<th>T2 Intervention (n=22)</th>
<th>T1 vs T2</th>
<th>T1 vs T1</th>
<th>T2 vs T2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(M \pm SD)</td>
<td>(M \pm SD)</td>
<td>(Z)</td>
<td>(p) values</td>
<td>(Z)</td>
<td>(p) values</td>
<td>(Z)</td>
<td>(p) values</td>
</tr>
<tr>
<td>RSOD</td>
<td>1.55 (.18)</td>
<td>1.18 (.20)</td>
<td>0.36</td>
<td>.19</td>
<td>1.60 (.16)</td>
<td>1.50 (.17)</td>
<td>-0.10</td>
<td>.68</td>
</tr>
<tr>
<td>Work/Study Consequence</td>
<td>0.96 (.17)</td>
<td>0.59 (.19)</td>
<td>-0.37</td>
<td>.08</td>
<td>0.82 (.16)</td>
<td>0.60 (.16)</td>
<td>-0.22</td>
<td>.23</td>
</tr>
<tr>
<td>Interpersonal Issues</td>
<td>0.61 (.17)</td>
<td>0.56 (.18)</td>
<td>-0.05</td>
<td>.80</td>
<td>0.51 (.15)</td>
<td>0.28 (.16)</td>
<td>-0.23</td>
<td>.16</td>
</tr>
<tr>
<td>Physically Unwell</td>
<td>1.05 (.16)</td>
<td>0.98 (.17)</td>
<td>-0.07</td>
<td>.74</td>
<td>1.08 (.14)</td>
<td>0.83 (.15)</td>
<td>-0.25</td>
<td>.15</td>
</tr>
<tr>
<td>PBS Alcohol Use</td>
<td>1.10 (.18)</td>
<td>1.07 (.20)</td>
<td>-0.03</td>
<td>.91</td>
<td>1.00 (.16)</td>
<td>1.61 (.17)</td>
<td>0.61</td>
<td>.003</td>
</tr>
<tr>
<td>PBS Alcohol Harm</td>
<td>0.99 (.23)</td>
<td>0.63 (.25)</td>
<td>-0.36</td>
<td>.21</td>
<td>1.04 (.21)</td>
<td>1.47 (.22)</td>
<td>0.43</td>
<td>.08</td>
</tr>
</tbody>
</table>

**Note.** RSOD = Risky Single Occasion Drinking, consumption of more than 4 Standard Drink in a single setting. PBS = Protective Behavioral Strategies applied for alcohol use or alcohol-related harm. T1= baseline, T2= follow up.

### Group by Time Main and Interaction Effects

The main and interaction effect of time and group upon the primary and secondary outcomes are evident in Table 3. There was no significant main or interaction effect of time or group upon the primary outcomes. There was a significant interaction of time by group in predicting changes in the secondary outcomes of PBS use for alcohol consumption \(B=.52, p=.03\), and PBS use for alcohol-related harm \(B=.82, p=.03\). Please refer to the graphical representation of these interactions in Electronic Supplementary Material 1.6 for more information.
Table 3. Main and Interaction Effects of Time and Group upon Primary and Secondary Outcomes

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>SE</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSOD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>0.62</td>
<td>0.51</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>-0.32</td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>-0.01</td>
<td>0.30</td>
<td></td>
</tr>
<tr>
<td>Time * Group</td>
<td>0.11</td>
<td>0.20</td>
<td>2</td>
</tr>
<tr>
<td>Interpersonal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-1.29</td>
<td>1.38</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>0.58</td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>0.52</td>
<td>0.79</td>
<td></td>
</tr>
<tr>
<td>Time * Group</td>
<td>-0.59</td>
<td>0.48</td>
<td>2</td>
</tr>
<tr>
<td>Unwell</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-0.00</td>
<td>0.70</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>0.07</td>
<td>0.43</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>0.16</td>
<td>0.41</td>
<td></td>
</tr>
<tr>
<td>Time * Group</td>
<td>-0.16</td>
<td>0.26</td>
<td>2</td>
</tr>
<tr>
<td>Work/Study</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>0.66</td>
<td>0.77</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>-0.57</td>
<td>0.60</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>-0.24</td>
<td>0.51</td>
<td></td>
</tr>
<tr>
<td>Time * Group</td>
<td>0.10</td>
<td>0.38</td>
<td>1</td>
</tr>
<tr>
<td>PBS alcohol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>0.73</td>
<td>0.59</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>-0.55</td>
<td>0.43</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>-0.61</td>
<td>0.39</td>
<td></td>
</tr>
<tr>
<td>Time * Group</td>
<td>0.52*</td>
<td>0.25</td>
<td>2</td>
</tr>
<tr>
<td>PBS harm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>1.08</td>
<td>0.93</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>-1.22</td>
<td>0.66</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>-0.79</td>
<td>0.58</td>
<td></td>
</tr>
<tr>
<td>Time * Group</td>
<td>0.82*</td>
<td>0.38</td>
<td>3</td>
</tr>
</tbody>
</table>

Note. RSOD = Risky Single Occasion Drinking, consumption of more than 4 Standard Drink (defined as consumption of an alcoholic beverage with 10 grams of alcohol). PBS = Protective Behavioral Strategies applied for alcohol use or alcohol-related harm.

* p < .05

Part Two Usability and Acceptability

Method

Participants

Participants were selected based on obtaining a sample with an equal proportion of males and females and matched approximately for the mean age of the larger sample. The sample included three male and three female participants (\(M_{\text{age}}=19.5\) years, \(SD_{\text{age}}=1.64\) years) from the intervention group. Formative usability trials have demonstrated that a sample of five participants can identify 80% of usability issues [32, 33].

Measures
Usability was assessed from the System Usability Scale (SUS) [34] and acceptability was examined through an interview schedule based on the Enlight measure [1].

**System Usability Scale**

The SUS [34] is an industry-standard 10-item scale [e.g., 35] that examines the usability of a technological tool. Responses are measured on a 5-point Likert-type scale with 1 (*strongly disagree*) to 5 (*strongly agree*). The SUS yields a composite score between 0 and 100, with higher scores indicating higher perceptions of usability. A SUS score greater than 68 is considered ‘above average’ and consistent with satisfactory usability [e.g., 36]. The SUS has been found as a reliable and valid tool among both experts and service users when assessing the usability of smartphone applications [37].

**Enlight**

A total of 10 open-ended questions were taken from the Enlight evaluation tool [1] and posed to participants during a one-on-one phone interview. These questions were designed to gain an in-depth understanding into the acceptability and usability of the app. Example questions include: “to what extent is the app an appropriate tool to use in reducing alcohol use?” and, “how easy was it to learn to use the app?”. **Procedure**

At the end of the intervention period, a subgroup of six participants engaged in a one-on-one phone interview with a trained research assistant who presented the following questions; basic demographics, the System Usability Scale, (SUS) and open-ended questions adapted from the Enlight Categories. The mean length of the interview was 35 minutes ($SD = 9.46$).

**Results**

**Thematic Analysis Procedure**

Thematic analysis was used to identify the recurring themes from the qualitative data, as outlined by Braun and Clarke [38]. All audio recordings were transcribed
verbatim and systematically double-coded independently among two researchers (RO, PS). Following in-depth review of the coded data, independent themes were developed based on recurrent content. Both coders (RO, PS) then engaged in a cooperative discussion of themes to decide on the most pertinent and recurrent aspects of coded data. The process of refining and reviewing themes was iterative until themes were representative of the data and saturation was achieved.

**Usability**

Quantitative usability data indicated high usability scores among the participants with the average overall score of 74.16 ($SD=9.31$), exceeding the acceptable cut-off score of 68 [36]. As shown in Table 1, participants felt that most people would be able to learn to use the app quickly and that they themselves felt confident using the app.

**Table 1** Means and Standard Deviations for the SUS

<table>
<thead>
<tr>
<th>Question</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>I think I would like to use the app frequently</td>
<td>3.50</td>
<td>0.55</td>
</tr>
<tr>
<td>I found the app to be unnecessarily complex</td>
<td>2.16</td>
<td>0.98</td>
</tr>
<tr>
<td>I thought the app was easy to use</td>
<td>3.66</td>
<td>1.03</td>
</tr>
<tr>
<td>I think that I would need support of a technical person to be able to use the app</td>
<td>1.33</td>
<td>0.82</td>
</tr>
<tr>
<td>I found the various functions in the app were well integrated</td>
<td>4.00</td>
<td>1.09</td>
</tr>
<tr>
<td>I thought there was too much inconsistency in the app</td>
<td>2.50</td>
<td>1.22</td>
</tr>
<tr>
<td>I would imagine that most people would learn to use the app very quickly</td>
<td>4.33</td>
<td>0.82</td>
</tr>
<tr>
<td>I found the app very cumbersome to use</td>
<td>2.33</td>
<td>0.52</td>
</tr>
<tr>
<td>I felt very confident using the app</td>
<td>4.17</td>
<td>0.75</td>
</tr>
<tr>
<td>I needed to learn a lot of things before I could get going with the app</td>
<td>1.66</td>
<td>0.82</td>
</tr>
<tr>
<td><strong>Overall SUS Score</strong></td>
<td><strong>M= 74.16</strong></td>
<td><strong>SD = 9.31</strong></td>
</tr>
</tbody>
</table>

*Note. Responses were scored on a 5-point Likert scale ranging from 1= Strongly disagree to 5= Strongly agree. Overall SUS score is out of 100*

**Acceptability**

The semi-structured interviews were informed by the Enlight evaluation framework [1]. Ten open-ended questions regarding acceptability, experiences of use and challenges of utilising the app were asked to a sub-group of participants. Thematic analysis revealed seven broad themes which are described below: four themes were related to the advantages of the app and three related to the challenges.

**Perceived Advantages of Minimise**

*Tailored Delivery of Protective Strategies*
All participants commented that the tailored delivery of the protective strategies was useful in providing specific, alcohol-reduction information, relevant to their context. Indeed, users felt that receiving information, matched to their context, enabled the application of the strategies into their drinking context as they were applicable:

“*There were different strategies for different scenarios so there was good advice for each environment which was easy to incorporate*”
[Participant 3]

The majority of participants appreciated being prompted to use these specific strategies in the drinking context (N=5/6). Specifically, users reported that without the prompting reminder it would be difficult to remember to implement the strategies:

“I liked the strategies the most, using those and when it prompted you if you have intentions to drink...if I wasn’t prompted I probably would’ve forgotten”
[Participant 5]

**Habit Formation**

The users commented on how the app check-in process had become habitual. Specifically, four of the six participants experienced *Minimise* as part of their daily routine stating that it had become routine to check in with the app when they were also engaging with other apps (i.e., social media):

“It’s become part of my app checking habit” [Participant 3]

Some participants referred to the app as having gamification elements that they felt were fun and enjoyable to complete, which provided a short distraction from reality (N=3/6). This further assisted the habit-formation of checking in with the *Minimise* app:

“It’s like having a game of bejewelled- it gives you two minutes of mindfulness”
[Participant 2]

**Increased Awareness of Drinking**

A prominent finding identified among all participants was that the app increased awareness in the user in two ways; first it helped the user identify how much they were drinking and second, insight into the circumstances preceding their decision to drink.

“It made me realise that I drink more than I realised and I only drink because I am with friends. I didn’t realise that before” [Participant 5]
Three participants commented that this self-awareness was particularly effective in prompting behavioral change in regard to their alcohol consumption and would have a lasting impact on their future drinking behaviors:

“Our quantity wise it’s definitely going to decrease – I knew that my tolerance level was a bit low, but I used to drink anyway but now I start to see the direct effect on my health and wellbeing.”

[Participant 3]

Insight into Current Emotional State

Whilst it was not an intention of Minimise, four out of the six participants reported that the app had helped them to reflect on their emotions, which in turn helped to inform their decision regarding alcohol use:

“Sometimes you just don’t feel like drinking, you might be sad, but it is a mate’s birthday, so you have to or a social situation where you have to. So, all those questions [in the app] helped me make the right decision.” [Participant 2]

Another user commented that the ability to monitor their emotional state helped them to understand why they were drinking:

“When I was filling in the emotions part of it every single day it made me go through a process of self-realisation - you don't often acknowledge why you drink.” [Participant 3]

Perceived Challenges of Using Minimise

Technical Issues

There were two technical issues identified by three out of six participants. First the notification schedule was inconsistent:

“Sometimes I wouldn’t even get the notification, so I then had to open the app”

[Participant 3]

Second, the slider used in the self-reports was temperamental for some items:

“Sometimes when I used to move the scale it used to get stuck. It would say this question is unanswered, but I did answer it. That used to get really annoying”

[Participant 6]

These types of errors impeded upon a small number of participants’ (N=2/6) motivation to use the app:
“The app was starting to glitch out a heap of times and I was getting really annoyed by that. I was contemplating quitting the study as I was getting sick of it”
[Participant 1]

**The Strategies were not Unique**

The main concern users had with the delivery of the PBS was that they were familiar with some of the strategies recommended within the app, and for some users (N=3/6), this lack of novelty reduced their engagement in the app:

“I have gone in and looked at my protective strategies a few times but a lot of them I have heard about from friends and school and so I haven’t looked over them too much” [Participant 4]

Most participants (N=4 out of 6) relied on the PBS that were novel and more specific to their situation rather than the familiar and more obvious suggestions:

“In terms of the general strategies provided like covering your drink or having a designated driver - they weren’t very specific so it wasn't that applicable” [Participant 3]

**The Lack of Certain Functions**

The large proportion of users (N=5/6) commented that they would have liked more functionality surrounding the ability to track progress whilst using the app. Users emphasised that if they were able to see how many drinks they were consuming on a frequent basis, and how this aligned with their goals, this would have better facilitated them to stay on track:

“It would be good to implement like a goal setting where people enter in their goals of how many drinks they want to have a week and then at the end of the week they can check” [Participant 1]

When asked how the strategies could be delivered in a more effective manner all users mentioned that it would be useful to include a function within the app in which the strategies that had been previously applied could be referred to at any time:

“I found it confusing because you couldn’t confirm whether or not you had used a particular strategy” [Participant 4]

**Discussion**
Accumulated literature suggests that PBS are a promising adjunct to treatment for risky drinking [e.g., 39]. Findings have been less consistent when PBS has been offered as a stand-alone treatment [e.g., 14]. In these prior implementations, participants have typically been given strategies at a single time-point that are not tailored to their context. To expand on these developments, Minimise, an EMI for young adults that combines self-monitoring functionality and tailored delivery of protective strategies, was developed. To evaluate this app, the aim of this pilot study was two-fold; (1) assess the efficacy of Minimise using a randomised controlled trial, and (2) examine the usability and acceptability of Minimise using a qualitative study design.

**Efficacy Findings**

In terms of RQ1, no significant decrease in alcohol use (i.e., RSOD episodes) or drinking-related harms (i.e., interpersonal) across time or group was identified. For RQ2, participants in the intervention group significantly increased their use of PBS at follow-up, as compared to the control group.

The intervention was successful in increasing the users’ application of PBS, however, this increased uptake was not shown to be associated with a reduction in risky drinking behaviours, as would be expected. There are two possible reasons for this. First, participants may not have implemented the PBS in high-risk situations. For example, perhaps users only applied the strategies to situations in which they felt comfortable reducing their alcohol intake, where there was no expectation to drink excessively (e.g., family gathering). In contrast, in situations with inherent pressure to drink (e.g., social events with peers), participants may not have had the capability to implement the appropriate strategies. Interventions incorporating PBS should include other techniques that can support the user to overcome potential barriers in the implementation of the strategies, particularly in situations where external pressure to drink is high. Indeed, drink refusal skills training has been shown to promote self-
efficacy and reductions in alcohol use, particularly in high risk social situations [e.g., 40, 41]. The purpose of this training is to teach the individual on how to adopt and enact more adaptive responses to social situations that involve alcohol use [42]. It would be advantageous for future app-based interventions to assess if the combination of PBS coupled with training on drink-refusal skills, generates reductions in risky drinking behaviors.

Second, it is also possible that some of the PBS strategies were not as effective as anticipated. A growing body of literature shows that there are some PBS strategy subtypes that are more effective in reducing alcohol use than others. Indeed, a number of studies [e.g., 43, 44] have shown that strategies which change the ‘manner of drinking’ (e.g., mixing different types of alcohol) are more effective in reducing alcohol use than strategies which aim to ‘limit consumption’ (e.g., set a limit on the number of drinks) or ‘avoid serious hazards’ (e.g., nominate a designated driver). The current study used all available strategies from the PBS framework in order to deliver a breadth and variety of information, and the requirement to disseminate strategies that were tailored to the person’s context. Nonetheless, interventions utilizing PBS may benefit from delivering only the strategies that have the strongest evidence in reducing alcohol use (i.e., manner of drinking) and excluding those that are less effective (e.g., limiting consumption and avoiding serious hazards).

**Efficacy Limitations**

This pilot RCT did not include a long-term follow-up and hence it is possible that some of the changes in drinking may not be detected by the immediate post intervention assessment used. Indeed, research shows that changes to drinking behavior, via the application of PBS, can take time as the individual requires the opportunity to enact the strategy in order for a change to drinking habits to take effect [e.g., 43, 45]. As such, it is possible that the current intervention had a positive, delayed effect upon
drinking behaviors, which would not have been discovered by the immediate-post assessment used. The current study adopted this post-intervention protocol based on prior alcohol-reduction EMIs [e.g., 46, 47], which use an immediate follow-up assessment to mitigate the risk of attrition and drop out. However, it is recommended that EMI studies, designed to alter habits surrounding drinking behaviors, include a longer-follow up period to ensure that if there is an intervention effect, it is captured.

**Usability Findings**

Interestingly, even though participants did not report a reduction in their drinking, the qualitative findings were supportive of the usability and acceptability of the Minimise app to reduce alcohol use. In particular there were three features of the app that were well-received by the users. First, users scored *Minimise* high on the SUS due to its streamlined interface and well-integrated functionality. This feedback is important in delivering an intervention for substance misuse. Indeed, it is probable that there will be times in which the user will be engaging with the app when they are drinking and possibly intoxicated. Ensuring the system is a straightforward one is essential for people to continue to engage with the app even if they are inebriated. Second, users agreed that a strength of the *Minimise* app was its tailored functionality. In turn, participants reported that this feature made the strategies highly transferable to the environment they were in. This finding echoes a number of research studies that show tailored information is more likely to be read, remembered and acted upon, in contrast to generic information [e.g., 48, 49]. Finally, participants commented that the self-monitoring functionality facilitated their understanding into how much alcohol they were drinking and the complex interplay between internal states, external factors and subsequent drinking behavior. This finding is consistent with a number of studies that have found self-monitoring useful in providing insight to and curtailing risky drinking behaviors [e.g., 50, 51].
Usability Limitations

Notwithstanding the positive feedback regarding Minimise, qualitative feedback identified two key areas in which the app could be improved. First, some participants were already familiar with the strategies suggested by the app and were hoping instead to find new approaches to reducing their drinking. When they recognised strategies, they reported being less interested and engaged in the app. Further instruction at the outset of the study that the app provides common sense, easy-to-implement approaches that may be familiar to the user, may serve to offset expectation that all the strategies will be novel and unfamiliar to the participants. A second limitation was the lack of advanced goal-setting functionality. While the self-monitoring component of Minimise was designed to facilitate monitoring and tracking of performance, more explicit messaging and prompts to remind participants of their goals (especially when they are struggling to maintain these) may be helpful. Indeed, research suggests the mere reminder of goals can be enough to keep participants on track with their intended behavior change [53, 54].

Implications and Conclusion

There are a number of implications that warrant consideration. First, the lack of efficacy findings suggest that more work is needed on the specific intervention content that is delivered within this app. More broadly, this finding suggests that PBS delivered as a standalone intervention, repetitively and tailored to the user’s goal and context, does not appear to be an effective method to reduce risky drinking behaviors among young adults, at least not in the short term. Future smartphone-based research that includes PBS components should pair this with additional intervention components that have a strong evidence base (e.g., implementation intentions [e.g., 55]; normative feedback [e.g., 56]; and drink-refusal skills training [e.g., 41]).

Second, the results of the qualitative study demonstrate Minimise as a highly
usable and acceptable tool in helping young adults reduce their alcohol consumption and drinking related harm in their everyday life. This finding suggests smartphone apps as a viable mechanism that researchers and health professionals can use to deliver drinking-based interventions. This is especially important for those working with young people, considering how notoriously difficult they are to engage in AoD programs [57], but yet how frequently they engage with their smartphone device [58].

In conclusion, this study found that users of the Minimise app significantly increased their application of PBS. Moreover, the app itself was rated by end-users as a highly acceptable and usable device to intervene on drinking behaviors. Despite these encouraging findings, Minimise did not effectively change drinking-related outcomes among young adults. This suggests one of two things; first, the Minimise app was ineffective in reducing the user’s drinking behaviors. Given the usability assessment revealed the app to be user-friendly, it is possible that the limited feature of the app is the intervention used, the PBS. As research findings suggest, PBS is more effective when delivered as part of a multicomponent intervention. Further work is needed to examine if a smartphone app that delivers PBS, coupled with other effective intervention components, can generate a reduction in the user’s risky drinking behaviors. The second possibility is that the effect of the intervention was delayed and in turn, not captured by the immediate follow-up assessment used. Further work is needed to verify these findings. With the significant potential that smartphone-based drinking interventions provide young people (i.e., accessibility, ease of use, no shame), it is important we as researchers invest in developing a smartphone app that can effectively reduce harmful drinking-behaviors among young people.


48. Wright C, Dietze PM, Agius PA, Kuntsche E, Livingston M, Black OC, Room R, Hellard M, Lim MS. Mobile Phone-Based Ecological Momentary Intervention to Reduce Young Adults' Alcohol Use in the Event: A Three-Armed Randomized Controlled Trial. JMIR mHealth and uHealth. 2018 Jul;6(7).
CHAPTER SIX: GENERAL DISCUSSION

It is widely agreed that motivation is an integral construct that drives human behaviour and is particularly relevant when understanding why individuals engage in risky drinking (e.g., Cooper, 1994; Cox, & Klinger, 1988). It has been argued in this dissertation that the way drinking motives have been operationalised and measured requires reconceptualising. That is, historically, drinking motives have been viewed as dispositional, stable constructs that are invariant across situations. This infers that the reasons and motivations a person has for drinking do not change within or between situations. Yet, empirical evidence shows that both the type of motivation, and the strength of the motivation can change substantially, depending on the active ingredients of the situation. For instance, when in the context of peers who are drinking in excess, a person may be motivated to drink to conform to these behaviours and drink alcohol in a heavy manner. Yet, when the same individual is surrounded by family at a celebratory dinner, they may drink to socialise and only consume a small quantity of alcohol. Furthermore, there is a large body of research that argues for target behaviours and their relevant determinants to be contextualised, measured within the environment that they occur (e.g., Mischel, Shoda, & Mendoza-Denton, 2002; Zuckerman, 2015). For example, researchers (e.g., Piasecki et al., 2011; Shiffman, 2009) who examine cigarette consumption and within-person changes, argue that ecological assessments are the most precise recording system to use as it can capture the associations between consumption and situational factors (e.g., affect and activities), that cross-sectional methods (i.e., surveys) miss.

Together, these lines of evidence were drawn together to inform the broad aim of this dissertation; to understand the role that both stable (i.e., dispositional drinking motives) and variable (i.e., drinking motives and drinking situation) factors have in influencing drinking-related behaviours. In addressing this aim, this dissertation makes
a significant contribution to the field of alcohol research, specifically, it focuses on both the dispositional drinking motivations and contextually derived factors that influence a young person to drink, excessively. This Chapter begins with a summary of the findings and concludes with the broader implications and future research directions based on this work.

**Summary of Findings**

This dissertation consists of three empirical studies including; a systematic review (Chapter Three), an Ecological Momentary Assessment (EMA; Chapter Four) and an Ecological Momentary Intervention (EMI; Chapter Five). A brief summary of each study is now presented.

The objective of Chapter Three was to synthesise the drinking motivational literature in a manner that attended to the role of the drinking situation. Historically, scholars have opted to define and measure drinking motives as dispositional in nature. Consequently, there has been a lack of attention and focus invested in examining how the drinking situation influences motivational processes. To date, Chapter Three is the first study that synthesises the role of the drinking context within the drinking-motivational literature. Specifically, this review addressed two research questions; first, what is the current evidence-base regarding the most significant situational factors which constitute the “drinking context” within the drinking-motivational literature? and second, how do these situational factors interact with one’s motivation to drink (both dispositional and momentary) to predict alcohol-related behaviours?

Evidence for three key situational factors relevant to drinking motives and subsequent alcohol use was identified within the literature; the social, interpersonal context (i.e., if the person is with other people or alone when drinking), the physical location of the drinking setting (i.e., whether the location was a private or public venue), and the individual’s momentary affect (i.e., positive and negative affect before or during the drinking event). These situational features were shown to share unique relationships
with drinking motives and drinking behaviours. More specifically, factors external to the individual, social interpersonal (i.e., being surrounded by other people) and the physical setting (i.e., being in a public venue) were associated with positively oriented drinking motives (i.e., social and enhance) and more episodic—but infrequent—drinking. Whereas internal affective states of the individual (i.e., negative affect) were associated with negatively oriented drinking motives (i.e., coping) and related to more habitual alcohol use.

Importantly, these findings assist our understanding in identifying the relationship between features of the drinking situation, drinking motives and drinking outcomes. However, there were constraints within this body of work that limited its validity in addressing the research questions. First, only a paucity of the studies conceptualised drinking motives as situation specific constructs (rather operationalising motives as only dispositional). Relatedly, these studies often conceptualised features of the drinking situation as confounds that needed to be controlled for rather than predictive determinants within the drinking-motivational process. As such, there were very few studies that conceptualised the drinking context as a multidimensional construct—a construct operationalised by more than one feature of the drinking situation—and no study that assessed all three features of the drinking situation (as identified as relevant in the review; social interpersonal context, physical location and momentary affect,). Therefore, no firm conclusions could be drawn regarding how the interplay between internal and external features of the drinking situation and drinking motivations (dispositional and momentary), propel a young person to engage in risky drinking.

This gap in the literature was addressed in Chapter Four; through the use of an Ecological Momentary Assessment (EMA), a multidimensional examination of the drinking situation was achieved (i.e., including affect, social context and location) and
its association to young adults’ drinking behaviours was examined. The results revealed two key findings. First, the social context, specifically being surrounded by peers who were also drinking, explained a significant amount of variance in both the initial decision to drink and the amount of alcohol consumed. In terms of drinking motivations, the study revealed a finding that contrasted with cross-sectional investigations. Specifically, momentary enhancement motivation was shown to facilitate the initiation of alcohol use but not the amount of alcohol consumed within a specific drinking occasion (conflicts with the literature that show dispositional enhancement motivation as predictive of a high quantity of alcohol consumption; e.g., Kuntsche, et al., 2008; Kuntsche & Kuntsche, 2009). This finding demonstrates that when motivations for drinking are measured in the moment, their relationship to drinking-related behaviours differs, as compared to their dispositional counterparts. This finding is explained in more detail in a later section of this Chapter.

Building on this, Chapter Five developed and evaluated an Ecological Momentary Intervention (EMI) which targeted the situational risk factors underpinning drinking initiation and consumption (identified from Chapter Four). The EMI delivered Protective Behavioural Strategies (PBS) tailored to individuals’ drinking-related goals (i.e., reduce alcohol consumption or harm) and drinking situation (i.e., external and internal features of the situation). The evaluation of the app was achieved in two-parts, a Randomised Controlled Trial (RCT) examined the efficacy of the app and a qualitative study design assessed the usability and acceptability of the app.

The RCT revealed a lack of efficacy; the PBS delivered as a standalone intervention via a smartphone, was not shown to generate change in the individual’s drinking outcomes. Indeed, while a significant increase in the use of PBS was achieved by the intervention group, there were no concomitant decreases found in alcohol consumption or harms. The end-users however rated the app as a highly acceptable and
usable device to reduce alcohol use, as evident in the qualitative assessment. The key implications of these findings are now described in the subsequent section.

**Implications**

There are a number of implications that relate to both research and clinical pursuits that can be deduced from this body of work. In particular: a stronger consideration of the situation is needed within drinking-related research studies; the utility and application of psychoeducational strategies within drinking interventions should be reconsidered; and important questions remain regarding the appropriateness of smartphone apps in facilitating health behaviour change.

A significant implication of this body of research is the importance of the drinking situation in understanding drinking behaviour in young people. To illustrate this point, consider that the EMA study detailed in Chapter Four found that when young people were exposed to a social context (i.e., with other people drinking), they were nine times more likely to drink themselves, in comparison to when they were not exposed to this context. This external feature of the situation was shown to share a stronger relationship with drinking, above and beyond dispositional drinking motives. And yet, alcohol-based research appears to be driven predominately by cross-sectional approaches that conceptualise and measure drinking determinants as only stable dispositions (e.g., drinking motives or personality characteristics; Kuntsche, Knibbe, Gmel, & Engels, 2005). Put simply, researchers have conducted studies where drinking behaviours are characterised only by distinctive qualities that are invariant across situations and time. There is accumulating evidence documenting that this is in fact, not the case. Therefore, researchers, health professionals and policy makers who work with alcohol use should be cognisant to the importance of the situation when examining why people drink.
The second implication of this dissertation comes from the findings of the EMI, *Minimise*, described in Chapter Five which offered insights to alcohol-research specifically and more broadly. The findings (or lack thereof) shared between PBS and a reduction in drinking behaviours may help to inform scholars and health professionals to the utility of disseminating psychoeducational alcohol strategies to young people. There is no denying that psychoeducational strategies show utility in educating young people on how to drink in a way that minimises harm (e.g., Steinhardt, & Dolbier, 2008). However, there is evidence from this dissertation directly and the literature more broadly (e.g., LaBrie, Napper, Grimaldi, Kenney, & Lac, 2015; Martens, Smith, & Murphy, 2013; Sugarman, & Carey, 2009) which show that PBS, when delivered as a standalone intervention (even when it is tailored to the individual’s situation and goal and repeatedly delivered over a significant period of time) does not appear to create significant change in the individual’s drinking behaviour. That is, it appears that PBS do not provide the young person with enough scaffolding and support to change their habitual behaviours regarding alcohol use, particularly in those high-risk situations that likely present many temptations to drink (e.g., other people drinking). It is important therefore, for future research studies and health professional to disseminate PBS paired with additional intervention components that have been shown as effective in reducing alcohol use (e.g., personalised feedback [Bewick et al., 2008], implementation intentions [Hagger et al., 2012] and drink-refusal skills training [e.g., Witkiewitz, Donovan, & Hartzler, 2012]).

A broader implication of these findings is the revelation that there is still substantial work required in understanding the role smartphone apps have within the field of health behaviour change. Technological advancements in smartphone apps have created more opportunities for intervention and treatment options to be delivered to people during times in which they need it most (e.g., Runyan et al., 2013). An
illustrative example is Just-In-Time Adaptive Interventions (JITAIs; Intille, 2004) that are increasingly being developed to support healthy behaviour changes (e.g., increased physical activity [King et al., 2013], alcohol reduction [e.g., Witkiewitz et al., 2014] and smoking cessation [Riley, Obermayer, & Jean-Mary, 2008]). Indeed, JITAIs use sensing devices (i.e., physical sensors, EMA or computer algorithms) to adapt the delivery of the intervention protocol based on the user’s affective, social and physical state (Nahum-Shani, et al., 2017). The goal of the JITAi is to deliver interventions options at moments in which they can most readily change a person’s behaviour (Klasnja et al., 2015). This affords a greater level of reach and accessibility of help in comparison to traditional forms of support (e.g., therapist directed; Cohn, Hunter-Reel, Hagman, & Mitchell, 2011).

Due to these obvious strengths of smartphone technology, there has been a recent surge in the number of smartphone apps that deliver intervention content for a range of health behaviours. But although there has been significant enthusiasm for delivering interventions via smartphone apps, evaluation of such research is in the early stages. As a result, the research findings are not well integrated limiting our understanding on what the most effective use is of smartphone apps in relation to health behaviour change. For example, a large proportion of behaviours detrimental to health have been intervened upon using smartphone technology (e.g., smoking [e.g., Businelle et al., 2016], alcohol misuse [e.g., Gonzalez & Dulin, 2015] and unhealthy eating behaviours [Boh et al., 2016]). Though, there has been no evaluation to date that has assessed if there are particular health behaviours that are more effectively intervened upon using smartphone technology as opposed to traditional forms of assistance. Furthermore, the precise details of which interventions should be delivered into individual’s natural environments for which health behaviours (e.g., unstructured clinical recommendations [strategies on how to reduce alcohol use] or more structured
interventions [Cognitive Behavioural Therapy]) and how they should be delivered (e.g., frequency of delivery, duration of intervention etc.) is unclear. Further investigation of smartphone-based interventions is needed that examines which content is the most effective to deliver for which specific target behaviours.

**Limitations and Future Research Directions**

As the limitations are specifically noted within each Chapter the subsequent section speaks to the broader limitations that impede on the studies of this dissertation, collectively.

First, there was a significant gender imbalance across the three studies. A larger proportion of females have engaged in this research, than males (e.g., Kuntsche, Knibbe, Gmel, & Engels, 2005; O’Hara et al., 2014). While not an unusual finding with a number of psychological research studies revealing an overrepresentation of females (e.g., Markanday, Brennan, Gould, & Pasco, 2013; Smith, 2008), it is problematic as there are distinct gender differences both in terms of drinking quantity and drinking motivations. First, males tend to drink in a riskier manner, consuming on average more alcohol than females (e.g., Capraro, 2000; Erol, & Karpyak, 2015). Second, males tend to drink for different motivations (e.g., more likely to drink for social and enhancement motives; Harrell, & Karim, 2008; Wilson, Pritchard, & Schaffer, 2004) and under different circumstances (e.g., drink more when with same sex friends; Kairouz, Gliksman, Demers, & Adlaf, 2002; Kuntsche, Otten, & Labhart, 2015) in comparison to females. Given these inherent gender differences which potentially were not represented in the imbalanced samples used within this dissertation, it is conceivable that the present findings are more relevant to understanding and predicting drinking behaviours of females, as opposed to both males and females. Research is needed that attends to both the nuances and complexities that drive males’ and females drinking behaviours, equally.
Second, this dissertation would have benefited from a more comprehensive measure of the drinking situation. While the three situational factors (i.e., social context, location and affect) found as relevant to motivated drinking behaviours in the systematic review were measured in each of the empirical studies, their specific features were not (e.g., how many people are present in the social context? Was there alcohol provided in the location? etc.). Especially given how important the social, interpersonal context was found in predicting drinking behaviours, it would have been useful to unpack this construct in more detail. While we know from the current study that the individual’s likelihood of drinking was increased substantially if they were with other people drinking, it is unknown if there were particular characteristics about these ‘other people’ that further compounded the likelihood of drinking. Social psychologists have long argued that people tend to emulate the behaviours of others in a social group setting if they perceive themselves to be similar to the reference group (e.g., Asch, & Guetzkow, 1951; Festinger, 1954). Furthermore, studies (e.g., Clapp, Shillington, & Segars, 2000; Hocking, Simons, Simons, & Freeman, 2018) show that the relationship between the individual and those they are drinking with, can influence the amount of alcohol they consume. An illustrative example comes from Robinson and colleagues (2016) who randomised young adults ($M_{\text{age}}$=26.4 years, $SD_{\text{age}}$=10.7 years) into a 2 x 2 design, with factors of acceptance by confederate (heightened [the confederate liked the participant and enjoyed their company] and; reduced [the confederate was distant and cold towards the participant]) and confederate drinking level (heavy drinking or low drinking). There was a significant interaction between the confederate drinking level and the acceptance by confederate toward the participant upon the amount of alcohol the participant consumed. Interestingly, when participants were exposed to a confederate with a high level of acceptance they drank in a similar manner to the confederate, consuming more alcohol in the presence of a heavy drinking confederate
versus a light drinking confederate. In contrast, when the participant was exposed to a confederate with a reduced level of acceptance, there was no significant effect of confederate drinking behaviour upon the participant’s drinking behaviour. It is essential that future drinking-based EMA studies examine if features of the interpersonal group including; the amount of alcohol consumed, the characteristics of the group and the relationship the individual shares with the group, influences the individual’s drinking behaviours. This can help to inform whether the risk factor for heavy drinking is simply being surrounded by another person/s drinking or whether the risk is only qualified if the other person/s who is drinking also exhibits particular characteristics (e.g., high acceptance, similar in age to the person etc.). This fine-grained information could then be used to inform interventions, particularly EMIs, in which the algorithm is tailored to the identified risk factor/s.

Finally, the empirical studies were constrained by the participants frequency of drinking episodes and the short follow up period. The EMA study described in Chapter Four adopted a 21-day study duration. While this duration is consistent with other EMA studies (e.g., Dvorak, Pearson, & Day, 2014), it only provided, on average, two occasions of alcohol use per participant. As described throughout this dissertation, drinking behaviours are dynamic in nature, their expression changes depending on the context the person is exposed to. With only a small number of drinking assessments (i.e., 180 drinking reports across 1,061 days of self-monitoring, 17%), it is possible there are other risk factors, perhaps more infrequent in nature (e.g., negative affect and coping motives) that do precede the occurrence of drinking though were not captured by this study. As a way in which to address this, recent EMA studies have employed a longer study duration (5 weeks) with less assessments (only assess participants on the Thursday, Friday and Saturday) to reduce response burden whilst obtaining a higher rate of drinking reports (e.g., Kuntsche & Labhart, 2013; Smit, Groefsema, Luijten, Engels,
& Kuntsche, 2015). Using this approach, Smit and colleagues found across 197 people, 40% of their completed assessments were alcohol reports (4,633 drinking reports across 11,516 total assessments). Future EMA studies, particularly those that examine the drinking behaviours of young adults who drink relatively infrequently, should consider balancing the duration of the study (e.g., extend the duration of the study protocol but reduce the response burden) against the timing of their assessments (e.g., restrict assessments to times were drinking is likely).

Relatedly, the EMI study would have benefited from a longer follow up period. Given the scope of the dissertation, only an immediate post intervention measurement was adopted, however it would have been beneficial to include a follow up assessment to observe if the intervention effect was in fact, delayed. Research shows that behaviour change takes time, indeed the individual needs to have the opportunity to enact the new behaviour in order for the habit to form and change to occur (e.g., Carden & Wood, 2018). And while the precise details surrounding the length of time it takes to change a drinking-related behaviour is not known, it was found in Lally, Van Jaarsveld, Potts, and Wardle’s (2010) study, 66 days is the median length of time in which health directed behaviours (i.e., consume more fruit, walk for 10 minutes) became automatic among a sample of young people. As such, it is possible that the current intervention had a positive, delayed effect upon the participant’s drinking behaviours, which would not have been discovered by the immediate-post assessment. It is recommended that EMI studies, designed to alter habits surrounding drinking behaviours, include a 3-month follow up time point to ensure that if there is an intervention effect it is captured.

Conclusion

It is a long-standing tradition within psychology to measure the dispositional characteristics of an individual as a way in which to understand the likelihood that they will behave in a certain manner, across situations (e.g., if a person exhibits a high trait
of impulsivity then they will act impulsively across situations). Yet, it has become increasingly evident that an individual’s behaviour varies considerably across situations, limiting the applicability of dispositional characteristics. Though, the way in which these dispositional traits have been conceptualised and measured in relation to drinking motivation, has been slow to change.

The overarching objective of this dissertation therefore, was to develop an understanding into the stable and dynamic determinants that underpin young adults’ drinking behaviours. This dissertation is an important first step that begins to inform how these mostly distinctive examinations (i.e., dispositional and momentary) can be integrated to understand problematic health behaviours, such as excessive consumption of alcohol. However, it is far from complete. Further examination of these determinants and their applicability in understanding and predicting drinking behaviours is needed. With technological advancements increasing, and methods, such as EMA at our disposable, researchers should harness the power of these techniques and further investigate how these stable and dynamic features interact to explain behavioural expressions such as risky drinking. Moreover, understanding how smartphone apps can facilitate drinking-related habit change by connecting specific environmental cues with desired responses, remains a key health and research priority.
References


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