IMPLICIT COGNITIONS AND UNDERGRADUATE DRINKING:
CONCURRENT AND PROSPECTIVE RELATIONSHIPS

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This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

Paul Masterman
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Note. A signed statement substantiating the student’s contribution to this paper can be seen in Appendix A.
Abstract

Alcohol use is prevalent in undergraduates and is associated with a range of health risk behaviours and negative consequences. Understanding factors that contribute to its uptake and development continues to be an important public health issue. Contemporary cognitive theories of addiction suggest that implicit memory processes have motivational implications for alcohol use. Previous research investigating the role of such processes in drinking outcomes has shown that implicit alcohol-related cognitions are predictive of composite indicators of undergraduate drinking in cross-sectional and prospective studies. However, several limitations to extant research exist. To begin with, concurrent investigations of implicit cognitions have not examined important quantity and frequency dimensions of drinking. It is unclear whether initiation of a drinking session (frequency) and continued consumption (quantity) may be differentially related to memory accessibility. Longitudinal models have been limited to two waves of data across relatively short periods of time (one month) and have not controlled for autocorrelations in memory measures. Three waves of data collection over a longer time frame might better assess prospective relationships between accessibility and drinking and may allow for capture of greater variability in consumption. Lastly, there has been limited research exploring the influence of contextual factors on accessibility for alcohol-related memory associations. According to social learning theory, context should be an important source of memory associations related to drug use and as such requires further exploration. In response to these limitations in the literature, this research program used memory association measures to further examine the role of chronic accessibility of alcohol-related memory, contextual accessibility of alcohol-related memory and their interaction in the prediction of undergraduate drinking.
Prior to conducting the research program outlined above, 325 undergraduates participated in two preliminary studies to refine existing memory association measures. Extant association tasks were developed in American university students and refinement was needed to account for any cross-cultural discrepancies in target items. The refinement process resulted in a set of target items that best predicted drinking among Australian undergraduates. Next, the refined memory association measure was used in cross-sectional analysis (Study 1) to investigate potential mediating mechanisms in the relation of associative strength to quantity and frequency dimensions of drinking. Responses from 214 undergraduates provided preliminary evidence that implicit alcohol-related cognitions may play a greater role in decisions to initiate drinking than in the quantity consumed at each session.

Extending on outcomes from concurrent analysis, Study 2 began with 162 participants and assessed longitudinal relationships between alcohol-related accessibility and alcohol use at three time points over a one-year period. Cross-lagged results support the utility of alcohol-related implicit cognitions to prospectively predict undergraduate drinking behaviours and vice versa. These results remained after competing explanations of previous use, autocorrelations between memory measures, sensation seeking, and background variables of age and gender were accounted for. Overall findings support suggestions that memory activation may be interpreted as either a predictor or a product of alcohol use.

Finally, Study 3 used 106 undergraduate participants to explore the influence of a contextual antecedent previously related to drinking (mood) on accessibility of alcohol-related memory. Results showed that positive mood facilitated accessibility in more experienced drinkers, supporting the proposition that an internal contextual cue (e.g., positive affect) may interact with chronic accessibility to predict individual
differences in drinking. Importantly, this study offers further evidence for mechanisms of implicit retrieval processing that might influence decisions to drink on one occasion and not another. Implications of the research program for prevention and treatment programs are discussed and suggestions for future research made. Overall, this research program offers further evidence in support of an implicit cognitions approach to alcohol use behaviours with applications to prevention and treatment efforts.
CHAPTER ONE

Rationale for the study of cognitive and behavioural models of alcohol use among university undergraduates: Expectancy theory and research
1.1 Introduction

The goal of the present chapter is to review the contribution of contemporary cognitive and behavioural models of alcohol use to the understanding of drinking behaviour in undergraduates. Towards achieving this goal, the following chapter begins with a rationale for the study of drinking in non-dependent university students. It is argued that frequency of heavy episodic drinking and associated problems in this population makes them a useful group for such study. An explanation of expectancy and social learning models of alcohol use follows. Expectancy theory has been the most extensively researched cognitive-motivational construct in the alcohol literature and is pivotal to the understanding of alcohol-related memory processes. A review of studies outlining the importance and contribution of explicit expectancy research to the understanding of drinking behaviour is given next. The chapter concludes with a summary of the empirical and conceptual limitations of this research.

1.2 Rationale for the study of non-dependent drinking among university undergraduates

Much evidence supports the widely held view that in Western society, alcohol consumption is a common feature of university undergraduate experience. Studies in the United States show that while young adults aged 18 – 21 have the highest rates of consumption compared to other age groups (e.g., Grant, 1997), university students have higher consumption rates, drink at risky levels more often, and show a greater number of alcohol-related problems than their non-university counterparts (O’Malley & Johnston, 2002; Weschler, Dowdall, Maenner, & Gledhill-Hoyt, 1998). In a recent summary of five large–scale surveys of U.S. college students, it was found that between 68 – 73% of undergraduates were drinking regularly over the past month and that between 38 – 44 % drank more than five drinks in a row in the past two weeks.
(O’Malley & Johnston, 2002). Comparisons between U.S. and U.K. undergraduate drinking patterns show that U.K. students may be consuming alcohol at twice the levels reported by American undergraduates (Delk & Meilman, 1996).

Among Australians, alcohol use is also common. The legal drinking age in Australia is 18 years, and this “coming of age” usually coincides with university entry. Alcohol use may be viewed as central to socialisation and rites of passage among Australian undergraduate populations and first year undergraduates may find themselves regularly exposed to opportunities and situations that facilitate drinking (Roche & Watt, 1999). The Australian Institute of Health and Welfare (AIHW, 1999) reported that 99% of Australians under the age of 19 have consumed alcohol; 49% between the ages of 14 and 19 years are drinking regularly (at least one day per week) and over 80% of all Australians, 14 years and older, are current drinkers (AIHW, 1999). Other studies have shown that 94% of 17-24 year old undergraduate students describe themselves as regular drinkers with 61% of males and 47% of females reporting consumption of five or more standard drinks per occasion (Roche & Watt, 1999). This pattern of consumption is defined as heavy episodic drinking (National Health and Medical Research Council, 1992).

1.2.1 Consequences of undergraduate drinking patterns

Heavy episodic drinking is associated with a range of health risk behaviours and negative consequences (Maio, Portnoy, Blow, & Hill, 1994; Pihl, Petersen, & Lau, 1993). Alcohol-related injuries and crashes are the leading cause of death among U.S. adolescents and undergraduates (Department of Health and Human Services, 1991; Institute of Medicine, 1990; McGinnis & Foege, 1993). In a sample of 167 Australian undergraduates, 34% reported driving a motor vehicle after drinking and 24% drove when they were aware they were intoxicated (Isralowitz & Borowski,
In university students, heavy episodic drinking has been associated with both smoking and alcohol-related problems (Weschler, Lee, Kuo, & Lee, 2000). Binge drinking also raises the risk of indiscriminate and unprotected sex (Cooper, 2002; Weschler, Davenport, Dowdall, Moeykens, & Castillo, 1994), sexual and physical assault (Engs & Hanson, 1985; 1990), and ethanol poisoning (Greenfield, 2001).

In sum, various environmental, legal, and developmental factors may converge in university settings to make undergraduates a useful population for the study of drinking behaviours and its related mechanisms. Variability in student drinking is high and research that furthers our understanding of current models of consumption may be important in informing interventions addressing problem drinking in this population.

1.3 Cognitive and behavioural models for understanding drinking behaviour: Expectancies and social learning

The construct of alcohol outcome expectancies (i.e., representations in memory of the expected outcomes of consuming alcohol; Leigh, 1989) have been the most extensively investigated cognitive-motivational construct in the alcohol field. The construct of expectancy is central to social learning and cognitive-behavioural approaches to models of alcohol use and has been used in cognitive explanations of drinking for a number of years (Goldman, Del Boca, & Darkes, 1999; Jones, Corbin, & Fromme, 2001; Stacy, 1997). The expectancy construct was first hypothesised as a direct mediator of behaviour by E.G. Tolman in 1932. Tolman argued that cognitive processes based on knowledge, planning, inference and purpose acted as intervening variables between stimulus and response. In a further explication of this approach, MacCorquadale and Meehl (1954) defined expectancy in terms of a learned association between a stimulus, a response, and the outcome of that response in the
presence of the stimulus. In this way, it was possible within Tolman’s framework to acquire expectancies by observation of the outcomes of various behaviours on others, without actually performing the behaviour and experiencing the outcome. In other words, Tolman’s arguments included the concept of vicarious learning, a mainstay of more recent social learning frameworks. This approach collaborates unobservable constructs derived from cognitive processes, with research on observable behaviour (Jones et al, 2001).

In 1972, Bolles further elevated expectancy constructs to a more central position in learning processes. Bolles argued that rather than learning about an association between stimulus and response, accompanied by reinforcement, people learn via two kinds of expectancies. The first kind of expectancy, R-S* (where S* denotes a stimulus functioning as a consequence) was the response/consequence expectancy. In this formulation, knowledge of the relationship between an individual’s response and environmental outcomes were acquired and stored in memory as expectancies. The other expectancy was the stimulus/ consequence expectancy, S-S*. This expectancy was learned when certain events or consequences (S*) were expected to be associated with particular external and internal events and cues or stimulus conditions (S). In other words, this describes the classical conditioning association formulation.

The notion that expectancies may play a causal, cognitive mediational role in behavioural outcomes is consistent with social learning theory and the concept of reciprocal determinism (Bandura, 1977). In this theoretical approach it is proposed that expectancies function autonomously and may guide behaviour even in the face of some amount of contradictory experience. Reciprocal determinism proposes a reciprocal relationship between behaviour and expectancies. Directly experiencing a
behavioural outcome should not only influence expectancy directly, but also modify the effects of expectancies as determinants of future behaviour. Bandura also proposed that humans not only hold expectancies that relate particular behaviours to desired outcomes, but also “efficacy” expectancies that are an individual’s higher order expectancies about whether he or she could successfully carry out the behaviours.

1.3.1 Alcohol and expectancies

Alcohol expectancies refer to the anticipatory cognition associated with drinking related behaviour and are central to cognitive-behavioural approaches to models of drinking (e.g., Oei & Baldwin, 1994). They may be defined as conditioned associations between drinking-related behaviour and its anticipated effects (Marlatt & Rohsenow, 1980; Wiers et al., 2003). The idea that expectancies might be important factors in the explanation of drinking was largely driven by observations that manipulating instructional set for drinking alcohol or drinking a placebo consistently influenced subsequent behaviour (Goldman, Brown, & Christiansen, 1987). Findings from balanced placebo studies showed that if participants believed they had consumed alcohol they showed effects consistent with drinking in the absence of ethanol ingestion (Hull & Bond, 1986). These findings were interpreted in terms of the outcomes people had expected to obtain from drinking alcohol (Marlatt & Rohsenow, 1980). However, as these studies required that expectancies be inferred from the behavioural outcome observed, they provided only indirect evidence that expectancies were in operation. Consequently, to further validate the utility of the expectancy construct it was necessary to find a more direct means of accessing expectancy content.
1.3.2 Expectancy questionnaires

To investigate the construct of alcohol outcome expectancies in memory, and to explore associations between expectancies and alcohol use, researchers used factor analytic methods to develop alcohol expectancy questionnaires. Early questionnaires such as the Alcohol Expectancy Questionnaire (AEQ) (Brown, Goldman, Inn, & Anderson, 1980) were made up of only positive expectancies as they were considered to be important motivators in decisions to drink. Positive expectancies include the endorsement of statements like ‘I expect to feel more social after drinking’ or ‘I expect to feel more sexually responsive after drinking’.

To develop the AEQ, Brown et al. (1980) obtained a list of 216 possible outcomes of alcohol use from interviews with 125 adults of varied drinking experience. These items were then administered to 450 college students and six expectancy domains were extracted. These domains were that alcohol was expected to: (a) transform experience in a positive direction (global positive effects); (b) enhance social-physical pleasure; (c) enhance sexual performance and experience; (d) increase power and aggression; (e) increase social assertion; and (f) reduce tension. Importantly, this methodology demonstrated that expectancies could be verbalised and assessed through self-report measures (Goldman et al., 1987).

While much of the theoretical and experimental work had focussed on the role that positive expectancies played in alcohol consumption, researchers investigated the role of expectations about the possible undesirable consequences of drinking (i.e., negative outcome expectancies; Christiansen, Goldman, & Inn, 1982). Christiansen and Goldman (1983) established seven expectancy factors in adolescents aged 12 to 19 years that included negative expectancies. These domains were: (a) alcohol is a powerful positive transforming agent; (b) alcohol can enhance or impede social
behaviour; (c) alcohol improves cognitive and motor functioning; (d) alcohol enhances sexuality; (e) alcohol leads to deteriorated cognitive and behavioural functioning; (f) alcohol increases arousal and (g) alcohol promotes relaxation or tension reduction. Adolescent expectancies were similar to those of the AEQ, but also included impeded social behaviour and negative or deteriorated cognitive and behavioural functioning. These domains were later used in the adolescent version of the AEQ (AEQ-A; Christiansen, Smith, Roehling, & Goldman, 1989).

Various instruments that contain both positive and negative statements have since been developed for use in adult populations. For example, the Drinking Expectancy Questionnaire (DEQ; Young & Knight, 1989) was developed using Australian populations. The DEQ had six expectancy domains. Three positive, measuring sociability, sexual enhancement, and tension reduction. Two negative domains measuring cognitive impairment and dependence, and one domain, affect change, containing both positive and negative items.

To investigate possible higher order global factors of positive and negative expectancies, a factor analytic approach using Structural Equations Modelling (SEM) was used to develop the Alcohol Outcome Expectancy Questionnaire (AOEQ) (Leigh & Stacy, 1993). Initially, an expectancy scale was constructed using open-ended responses about the effects of drinking. Both positive and negative outcomes were sought from 291 undergraduates, 56 high-risk drinkers in a college prevention program, and 166 drink driving offenders. The resulting 137-item scale was administered to 583 college students (50% female) and analysis revealed two global factors of positive and negative expectancies as the best solution. To determine whether more specific indicator factors of positive and negative expectancies were
completely subsumed under higher order global factors in terms of their prediction of alcohol use, a second study was undertaken.

In Study 2 (Leigh & Stacy, 1993), subjects were 588 introductory psychology students (266 males and 322 females). The higher order structural model was specified such that the positive expectancy indicator factors (social facilitation, sex, fun, and negative reinforcement) were found to load on a second-order factor of Positive Expectancy. Negative Expectancy indicators (negative emotions, negative social behaviour, physical discomfort, and cognitive/performance impairment) were loaded on a second-order factor of Negative Expectancy. Results showed that along with global positive and negative expectancies, specific positive indicators of fun, social facilitation, and sexual enhancement were unique predictors of alcohol use. While results supported a global factor for negative expectancy, positive expectancy appeared to contain several unique subfactors in the prediction of drinking.

It has also been suggested that endorsement of expectancies scales reflect associations of alcohol constructs in long-term memory (e.g., Goldman, Brown, Christiansen, & Smith, 1991; Rather, Goldman, Roehrich, & Branick, 1992; Goldman & Darkes, 2004). One such cognitive model was derived from responses on Likert scales to the phrase “drinking alcohol makes me…….” Using Multidimensional Scaling (MDS) the expectancy network was mapped in expectancy space. The resultant markers were consistently distributed in two dimensions. Outcomes of drinking are positive or negative and arousing or sedative, with heavier drinkers anticipating greater positive arousal and lighter drinkers anticipating greater positive sedation (Goldman, Del Boca, & Darkes, 1999). Goldman, (1999) has defined alcohol expectancies as “representations in long term memory of the direct and
vicarious learning experiences an individual has had with alcohol as a consequence of the person’s particular environmental exposure and genetic characteristics” (p.196).

1.4 Expectancies and concurrent drinking

1.4.1 Positive expectancies

Research using expectancy questionnaires has documented frequent demonstrations of an association between positive alcohol expectancies and drinking behaviours in adult and undergraduate populations. This finding has been supported in many cross sectional studies (e.g., Brown, Goldman, & Christiansen, 1985; Fromme, Stroot, & Kaplan, 1993; Mooney, Fromme, Kivlahan, & Marlatt, 1987; Palfai & Wood, 2001; Leigh & Stacy, 2004). In the seminal work of Brown and colleagues it was found that expectations of global positive changes predicted increased drinking (Brown et al., 1980). In later work, heavier drinkers expected more social and physical pleasure, tension reduction and social assertion (Brown et al., 1985).

Responses to expectancy questionnaires have distinguished between alcoholics, problem and non-problem drinkers (Brown, et al., 1985; Connors, O’Farrell, Cutter, & Logan-Thompson, 1987). Brown et al. compared the alcohol expectancies of 171 alcoholics receiving treatment with 65 non-alcoholic medical patients that were matched on age, gender, race, income and marital status. The non-alcoholic medical patients were further divided into heavy drinking and non-heavy drinking groups. It was found that alcoholics reported significantly higher scores on expectancy scales than did both groups from the medical patients. Furthermore, non-heavy drinking medical patients reported substantially lower scores than both alcoholics and heavy drinking medical patients. Connors et al. (1987) reported similar findings in that alcoholics and non problem-drinkers were distinguished on
expectations of sexual arousal, tension reduction, physical and social pleasure, aggressive arousal and global positive changes.

1.4.2 Negative expectancies

While much research indicated an association between positive expectations and alcohol use, research into negative expectancies had received little attention. In response to this situation, Jones and McMahon (1994) developed the Negative Alcohol Expectancy Questionnaire (NAEQ), representing only negative expectancies. The general evidence from the literature is that the more positive expectancies an individual endorses, in terms of both number and strength (as indicated by Likert scales), the more alcohol he or she will report consuming (for reviews see Goldman, 1994; Jones & McMahon, 1998). With respect to negative expectancies, early research showed mixed results. For example, research using the Comprehensive Effects of Alcohol Questionnaire (CEOA) found a negative relationship between negative expectancy and consumption in young and mature adults (Needham, Jones, & Taghavi-Laryani, 1998). Similarly, Fromme et al. (1993) found that positive but not negative expectancies were associated with three measures of alcohol use in a college student sample. In contrast, studies using a combination of the AEQ and NAEQ found that negative expectancies were associated with alcohol consumption for young and mature adults (McMahon, Jones, & O’Donnell, 1994).

In a review of the literature, Jones et al., (2001) made a compelling argument that findings have differed according to the expectancy measure used. These authors argued that differences in proximity of negative consequences to drinking might play a significant role in explaining these apparently systematic differences. The CEOA measures only proximal expectancies related to cognitive and behavioural negative effects of drinking. By contrast, the NAEQ taps both proximal and distal negative
outcomes such as hangover the following day and longer term effects of consistent heavy drinking such as relationship problems or getting into debt. When these more distal negative outcomes were made available for endorsement in questionnaires, they showed a positive association with alcohol consumption.

Leigh (1989a) has argued that positive effects of alcohol consumption are largely proximal and negative effects are largely distal. Because of this, dimensions of proximal and distal outcomes are related to dimensions of positive and negative expectancies. Studies have shown that university undergraduates expect more positive effects of alcohol for the rising limb of the blood alcohol curve and more negative effects for the descending limb (Earlywine & Martin, 1993; Dunn & Earlywine, 2001). This finding is in line with the pharmacological effects of ethanol ingestion. Other studies have added to the evidence that negative expectancies might play an important role in explaining drinking behaviours. For example, Grube, Ames, and Delaney (1994) found that negative expectancies were better predictors of drinking than positive expectancies when investigating workplace drinking.

A recent study used SEM analysis to investigate the role of positive and negative expectancies to predict alcohol use across different age groups (Leigh & Stacy, 2004). Data were collected from 2,875 U.S. residents aged 12 and older as part of the National Alcohol Survey in the United States (Midanik & Clark, 1994). Both positive and negative expectancies were found to be important predictors of drinking with their relative power differing according to age group. Positive expectancies were more strongly associated with drinking in younger age groups (under 35 years) compared to older age groups. For older age groups, negative expectancies were more influential predictors than positive expectancies. It was also found that age group was confounded with proportion of drinkers. Younger groups aged 12 –17
years contained fewer drinkers (32%) compared to 18-60 year old participants (65-74%), and those over 60 years of age (48%). When non-drinkers were removed from the sample, positive expectancies dominated as the best predictor of drinking. However, among older respondents in the full sample, negative expectancies predicted drinking more strongly than positive expectancies, while positive expectancies were stronger in the drinker-only sample. Leigh and Stacy (2004) posit that these differences suggest negative expectancies may predict abstinence in older participants. The authors conclude that negative experiences with drinking over time may lead to stronger expectations of negative consequences and less drinking (e.g., Jones & McMahon, 1998).

Jones and McMahon (1998) have outlined a model that attempts to integrate the roles of positive and negative expectancies across the spectrum of consumption to include people with severe alcohol problems. The authors suggest that the role of negative expectancies change as drinking increases to problem levels. Individuals are presumably motivated to begin drinking by the expected positive outcomes of doing so. As the person’s experience with increasing quantities of alcohol continues however, so does their experience of the negative consequences of drinking. At lower levels of consumption, negative expectancies do not impact behaviour. However, if for reasons of learning history or genetic inheritance, positive expectancies are more strongly held by particular individuals, then drinking will continue to increase to heavy and problem levels. Around this point, rising levels of negative outcomes will continue to be experienced until expectations of negative outcomes become so strongly associated with drinking cues as to begin to impact behaviour. This impact could take the form of seeking treatment to help reduce drinking or motivating other self-directed efforts to control alcohol consumption. In support of the model, several
studies have investigated levels of negative expectancies held among problem
drinkers at treatment (Jones & McMahon, 1994; 1996; McMahon & Jones, 1996). It
was found that motivation for help seeking among problem drinkers was consistently
related to endorsement of high levels of negative expectancies that were now more
salient than when they were drinking without problems.

1.4.3 Expectancies and quantity/frequency dimensions of drinking

Although expectancies have predicted composite indices of drinking, these
indices may fail to account for heterogeneity in drinking patterns such as frequent
light drinking and infrequent heavy drinking (Mooney, Fromme, Kivlahan, & Marlatt,
1987). Given that evidence suggests differential roles of positive and negative
expectancies in predicting overall consumption, it would be reasonable to expect
different patterns of expectancies to explain different drinking styles. Frequency of
drinking (i.e., the number of drinking occasions) and quantity of drinking (i.e., the
amount consumed per occasion) are distinct aspects of alcohol use that may be
differentially explained by expectancies. Furthermore, studies have found low
correlations between frequency of drinking initiation and quantity consumed,
indicating that both measures are required to adequately define consumption (e.g.,
Vogel-Sprott, 1974).

To investigate the effects of positive expectancies on quantity and frequency
of drinking, Mooney et al. (1987) administered the AEQ (Brown et al., 1980) to 157
males and 168 female undergraduates. It was found that while amount consumed was
predicted by social and physical pleasure and social assertion expectancies, frequency
of drinking was predicted by global positive changes, sexual enhancement and tension
reduction. Positive expectancies differentially explained 6% of the variance in
frequency and 15% of the variance in quantity consumed after controlling for background variables of age and gender.

Lee, Greeley, and Oei (1999) assessed the relative contribution of both negative and positive expectancies on quantity and frequency of drinking in a community sample of social drinkers with the Drinking Expectancies Questionnaire (DEQ; Young & Knight, 1989). Using hierarchical regression analysis to control for age, gender, and alcohol dependence, the authors found that for adult social drinkers, both positive and negative expectancies were differentially related to quantity and frequency of consumption. Participants who endorsed higher levels of expectations for increased assertiveness and cognitive enhancement (positive expectancies) showed a pattern of high quantity but low frequency of drinking. This suggests a trend toward binge drinking for these people. In contrast, those who endorsed higher levels of expectations for negative affect change (negative expectancies) drank lower quantities per session. However, negative affect was unrelated to frequency of drinking. In other words, expectations of negative affect change reduce the likelihood of binge drinking by reducing consumption regardless of the number of times drinking is initiated.

In explaining their results, Lee et al. (1999) suggested that if quantity was conceptualised as an indication of the point where drinking stops, the quantity one drinks at each session might reflect mechanisms responsible for limiting alcohol consumption. Frequency, on the other hand, indicates the number of times one starts drinking and could therefore reflect mechanisms responsible for an initial decision to drink. According to this view, decisions to begin drinking may be driven by positive expectancies whereas decisions to limit quantity may be driven by negative expectancies that are more distal from the initial decision to begin drinking.

1.4.4 High and low dose-related expectancies
In addition to the findings that people hold both positive and negative alcohol expectancies, it has been suggested that expectancies vary with the dose of alcohol concerned (Collins, Lapp, Emmons, & Isaac, 1990; Connors, et al., 1987; Weirs, Hoogeveen, Sergeant, & Gunning, 1997). Conceptually, four types of expectancies would result from a combination of dose and valency. Positive expectancies for a low dose, positive expectancies for a high dose, negative expectancies for a low dose, and negative expectancies for a high dose.

A study of Dutch secondary school pupils (aged 11 to 17 years) and university students (average age 22 years) used the four types of expectancies outlined above to predict current drinking patterns in adolescents and young adults (Wiers et al., 1997). It was found that for adolescent boys aged 16 years and older, endorsements of high-dose positive expectancies were better predictors of drinking than low-dose positive expectancies. These boys also reported greater endorsement of high-dose positive expectancies and less endorsement of high-dose negative expectancies compared to adolescent girls and university students. Similar results were also found for those younger boys (under 16 years) who had already initiated drinking. Expectancies paralleled binge-drinking patterns for these two groups such that those boys who reported positive expectancies for high doses of alcohol showed increased heavy episodic use (i.e., both groups reported an average consumption of 6.5 drinks per drinking occasion). Wiers et al. (1997) concluded that their findings highlight the importance of positive and negative expectancies for high-doses of alcohol in the prediction of binge drinking in Dutch adolescent males.

1.4.5 Integration

Studies reviewed thus far have addressed concurrent relationships between alcohol use and expectancies in undergraduates, community samples and adolescents.
Overall, results suggest a consistent association between responses to explicit expectancy questionnaires and drinking. However, findings regarding the relative contribution of positive and negative expectancies to drinking outcomes across quantity and frequency dimensions of drinking remain equivocal. One study indicates that positive expectancies may differentially predict quantity and frequency of drinking (Mooney et al., 1987), while other studies show that both positive and negative expectancies may predict these drinking patterns (e.g., Fromme et al., 1993; Mc Mahon et al., 1994). Later research indicates that decisions to initiate drinking may be related to positive expectancies while decisions to limit quantity may be driven by negative expectancies (Lee et al., 1999). Attempts to explain these mixed findings have related different positive and negative outcome expectancies to the proximal and distal effects of alcohol consumption (e.g., Jones & Mc Mahon, 1998). An important issue is that concurrent studies cannot speak to causal associations among variables and may not be sufficient to justify the inclusion of expectancies in interventions for drinking problems (Jones, et al., 2001). To make causal inferences, and to support the role of expectancies in treatment efforts, investigation of the prospective relationships between expectancies and drinking was required.

1.5 Prospective expectancy research

Several longitudinal studies have been undertaken to validate cross-sectional relationships and provide insight into possible causal associations between expectancies and drinking (e.g., Sher, Wood, Wood, & Raskin, 1996; Stacy, Widaman, & Marlatt, 1990). Prospective studies have shown that expectancies are stronger predictors of future problem drinking in adolescents than are a range of competing hypotheses (Christiansen & Goldman, 1983; Reese, Chassin, & Molina, 1994). Christiansen and Goldman compared the power of expectancies with that of
respondent’s age, attitude about acceptability of drinking, parental drinking behaviours and socioeconomic status to predict adolescent drinking. It was found that while risk factors predicted problem-drinking style, adding alcohol expectancy scales significantly increased predictive power. Christiansen et al. (1989) found that for adolescents aged 11 to 14 years, positive alcohol expectancy domains for enhanced social behaviour and improved cognitive and motor functioning explained 26% of the variance in drinking over a 1-year period. Furthermore, these expectancies predicted 13% of the variance in progression from non-problem to problem drinking over the following year. A weakness in this study was that autocorrelation of alcohol use was not controlled for in the analysis, nor were changes in drinking and expectancies assessed at each time point. As a result, explanatory effects of expectancies could simply be the consequence of heavier drinking patterns at Time 1.

Subsequent prospective research over a three-year period that controlled for autocorrelations in drinking found that among adolescents, alcohol consumption at year 1 predicted expectancies at year 2, and year 2 expectancies predicted drinking at year 3 (Smith, Goldman, Greenbaum, & Christiansen, 1995). These findings were further supported in a two-year study of Norwegian adolescents. Using structural equations modelling in a three-wave longitudinal design, Aas, Leigh, Anderssen, and Jakobsen (1998) found that expectation of positive social effects of alcohol predicted both initiation of drinking as well as future consumption. A more recent prospective study by Cumsille, Sayer, and Graham (2000) found that exposure to peer and adult drinking predicted the rate of change in positive alcohol expectancies over a three-year period for adolescent males and females. Over the course of all three studies mentioned above, a substantial increase in overall drinking was found, and expectancies became more positive over time. This suggests a reciprocal relationship
between drinking and expectancies such that changes in expectancies reflect changes in drinking and vice-versa.

Two studies have assessed prospective relationships between expectancies and drinking in undergraduates and young adults. One longitudinal study followed 584 college students (71% female) over nine years from late adolescence (mean age 18 years) to early adulthood (mean age 27 years). Results showed that expectancies in late adolescence predicted alcohol use and the development of problem drinking in adulthood after controlling for existing levels of alcohol consumption (Stacy, Newcomb, & Bentler, 1991). A more comprehensive study assessed positive expectancies and drinking behaviours of 458 undergraduates annually over four years (Sher et al., 1996). Half of the sample consisted of children of heavy drinkers (COHDs). A derived measure of expectancy strength was created using a combination of four positive expectancies (tension reduction, socialisation, activity enhancement, performance enhancement). Expectancies prospectively predicted alcohol use over a three-year period, and COHDs reported higher positive expectancies than other participants did. Findings from these studies provide support for the role of expectancy constructs as cognitive motivators that may influence later drinking behaviours.

1.6 Theoretical explanations of findings: A two-process model of expectancies

Although a large research literature supports expectancy constructs as important factors in explaining the development and maintenance of drinking, a theoretical framework for the structure and role of these constructs was required. One recent explication of expectancy theory has proposed a two-process model consistent with social learning frameworks that incorporates memory processes as fundamental to the development and maintenance of drinking behaviour (Oei & Baldwin 1994).
The model has two phases, an acquisition phase and a maintenance phase. While the model is inclusive, the proposed mechanisms in each phase call on different aspects of learning and memory processes. The acquisition phase of the model involves controlled decision making processes that include judgement and introspection and relates to expectancies as operationalised by self-report measures. Consequently, the acquisition phase is described next. The maintenance phase relates to more automatic cognitive processes that are most appropriately covered in Chapter Two.

1.6.1 Acquisition phase

In the acquisition phase of the two-process model, it is proposed that initial decisions to drink are based on positive expectancies derived from early vicarious learning experiences. Within a social learning framework it is presumed that the set of alcohol expectancies held by a person are learned and result from their direct and indirect experience with alcohol and alcohol-related concepts. Empirical support for the concept of vicarious learning in the literature has been extensive (Adler & Adler, 1977; Bandura, 1984; Bandura, Ross, & Ross, 1963), and social learning theory can readily account for different sets of individual expectancies via direct and indirect experience of behaviour. For example, one study has shown that children as young as three from families with a parent with alcohol problems had developed alcohol schemas (Zuckner, Kincaid, Fitzgerald, & Bingham 1995). Alcohol expectancies have also been found in children by age six (Miller, Smith, & Goldman, 1990), as well as adolescents (Christiansen & Goldman, 1983) prior to them having any direct experience with alcohol. Christiansen, Goldman, and Brown (1985) found that positive alcohol expectancies held by 12 to 14 years old adolescents, who had little or no direct experience with alcohol, were similar to those of older adolescents and college students. Evidently, children and adolescents develop expectancies about the
outcomes of drinking before experiencing the effects of ingesting ethanol. This development of expectancies must be derived from learning experiences other than actual consumption (Goldman et al., 1991).

The acquisition phase of the two-process model continues (presumably driven by positive expectancies as outlined above) with existing expectancies being compared with direct experience in each new drinking episode. Shiffrin and Schneider (1977) describe this learning as a controlled process that requires conscious and effortful attention. Individuals are presumed to engage in a comparison of perceived outcomes with actual consequences and if inconsistencies are found, cognitive effort is required to assess differences and form new expectancies or modify current ones. These consequences of drinking in response to various alcohol-related cues provide a feedback loop to the cognitive construct. With repeated experience, the link between cognitions and drinking is proposed to strengthen (Oei & Baldwin, 1994). This link is a key issue in the maintenance phase of the two-process model that will be the focus of discussion in Chapter Two.

In summary, the two-process model posits that pre-existing expectancies (composed from any mix of the above variables encountered prior to alcohol use) contribute to the uptake of alcohol use. It is proposed that during the acquisition phase, drinking may result from an interaction between a “blueprint” of expectancies, derived from early vicarious learning, and direct experience of alcohol consumption. At the very least, prospective evidence suggests that expectancies could be a motivating factor contributing to initial experimentation with alcohol use (e.g., Smith et al., 1995; Ass et al., 1998).

1.7 Limitations of explicit expectancy measures

1.7.1 Research limitations
Substantial research has been reviewed above suggesting that scores on expectancy questionnaires predict drinking behaviour cross-sectionally and may show a reciprocal relationship longitudinally. Where contributing demographic factors of age and gender have been controlled for in the analysis, expectancies have been found to explain 6% of the variance in frequency and 15% of the variance in quantity of drinking (e.g., Mooney et al., 1987). In other studies where previous drinking and/or attitudes towards drinking have been added to the prediction equation, expectancies have explained 1-3% of the variance in frequency and 2-3% of the variance in quantity of drinking (Carey, 1995; Leigh, 1989a). Therefore, while studies indicate a relationship between expectancies and drinking, their overall contribution beyond simple demographics appears modest.

1.7.3 Conceptual limitations

In addition to the modest effect sizes reported in expectancy research, measures of expectancies have shown heterogeneous associations with drinking both across and within studies. For example, in an influential review of 38 studies that used one of the most popular expectancy measures, the AEQ, it was found that none of the AEQ subscales were consistently predictive of drinking (Leigh & Stacy, 1991). In studies of adults, global positive effects, social assertion, and social and physical pleasure scales all predict drinking, but none do so in more than half of the analyses. Further to this, Leigh (1989b) has been critical of the discriminant validity of the subscales of expectancy questionnaires that have been based on exploratory factor analysis. She has noted that items often loaded on multiple factors, meaning that the predictive utility of the subscales is limited. Leigh points out that researchers using these scales have consistently treated them as discrete and independent predictors of alcohol use, and that this is an unjustified assumption. However, Leigh also states that
this does not mean that the scales do not measure alcohol expectancies, only that the subscales do not discriminate well. As such, she postulates that alcohol expectancy questionnaires may reflect more global, higher order constructs.

In response to this criticism, Goldman, et al. (1991) has suggested that the pattern of unique and common components of variance in the AEQ factors fits a network model of memory. In this view, the logic of factor analysis (i.e., that factors predict indicators) provides a basis for proposed dimensions that reflect some underlying characteristic of expectancies (e.g., positive or negative, arousing or sedating) and these expectancy concepts are represented in memory as nodes in an interconnected information network (Goldman & Darkes, 2004). However, endorsement of judgement tasks such as the AEQ may not be based on long-term memory and may involve different computational or working memory processes (Stacy, Newcombe, & Bentler, 1991). It is therefore unlikely that responses to expectancy questionnaires reflect associative memory models, especially given that such tasks were not constructed to assess associations among concepts in long-term memory (Stacy & Leigh, 1991).

Another explanation for the limitation of alcohol expectancies to consistently predict drinking could be related to the ease with which alcohol-related information in memory comes to mind (i.e., accessibility in memory) and this might vary between individuals. When an individual endorses an explicit expectancy questionnaire, responses may inform about the availability (i.e., the presence) of alcohol-related information in memory via introspection and deliberation, but not about the ease of recall or accessibility of this information. Thus, two individuals may report similar expected outcomes of drinking as available in memory when completing a questionnaire, but have different levels of accessibility for that information when not
involved in deliberation and conscious processing of alcohol-related memory. Availability in memory is necessary but not sufficient for the remembering or use of alcohol-related information in any given situation and what an individual consciously reflects on and records on a questionnaire might have little bearing on actual decisions to drink. Accessibility however, is a relevant concept to alcohol use because it emphasises the highly conditional nature of memory activation that may be dependent on cues and processes (e.g., Hintzman, 1986). Accessibility may therefore be a reasonable confounding variable in the relationship between expectancies and drinking.

1.8 Integration and conclusion

The high variability in alcohol consumption and the presence of problem drinking patterns among university undergraduates indicates a need for further study of drinking behaviours and related mechanisms in this population. The construct of alcohol outcome expectancies and related research has made a significant contribution to the understanding of undergraduate drinking behaviours. In accord with the acquisition phase of the two-process model of expectancy theory, prospective evidence suggests that expectancies could be a motivating factor contributing to experimentation with the uptake of drinking in adolescents and young adults.

Despite these findings, substantive and conceptual limitations in explicit expectancy research have been raised. The overall variance in drinking explained by expectancies appears modest, and there appears to be significant heterogeneity in the association of expectancy subscales content and drinking behaviour across individuals and studies. Although the conscious deliberation involved in responding to explicit expectancy questionnaires may tap the availability in memory of information about alcohol-related expectations, it might not account for variability in the accessibility of
such information. Consequently, the role of memory accessibility for alcohol-related outcomes in drinking behaviours requires further investigation.
CHAPTER TWO
Implicit cognitions and undergraduate drinking: Chronic accessibility of alcohol-related memory networks
2.1 Introduction

Chapter One concluded that explicit alcohol outcome-expectancy research might not adequately explain proposed underlying memory processes and that accessibility in memory for alcohol-related concepts may be a reasonable source of error in the relationship between expectancies and drinking. More recent cognitive theories of alcohol use emphasise the role of implicit memory activation and automatic information processing in determining drinking outcomes. The present chapter aims to review these developments in cognitive theories of drinking and summarise the contribution of implicit cognition research to the understanding of undergraduate alcohol consumption. The overall evidence may be construed in terms of the role of chronic accessibility of alcohol-related memory networks in undergraduate drinking behaviours.

2.2 An information-processing approach to alcohol use

2.2.1 The two-process model

In the acquisition phase of the two-process model (see Section 1.7), individual learning history and conscious cognitive processes are proposed to contribute to the initiation of drinking. In the maintenance phase of the model, repeated experience with alcohol means that drinking becomes increasingly associated with internal and external cues. While the individual has engaged in controlled decision making processes to initiate drinking in the acquisition phase, drinking behaviour in the maintenance phase is seen as a conditioned response to alcohol-related cues. It is proposed that with multiple trials, alcohol-related cognitions become classically conditioned to internal and external stimuli, producing an expectation of reinforcement that motivates future drinking in the presence of related cues. In this model, classical conditioning is seen as a fast and automatic process and
reinforcement is not contingent upon drinking. Instead, drinking is proposed to occur in the presence of alcohol-related cues that are conditioned to expectations of reinforcement. The essential point of the model is that over time, drinking behaviours, expected outcomes and alcohol-related cues become bound together in an automatic process in which accessibility in memory is the key factor determining individual behavioural outcomes (Tiffany, 1990).

2.2.2 A memory network-based approach

The view that alcohol expectancies are associated in memory with situational and affective cues and drinking behaviours has considerable conceptual overlap with network models of memory processes (e.g., Collins & Loftus, 1975; Masson, 1991). In semantic network theory, alcohol expectancy concepts are made up of information about unique situational and affective alcohol cues, words, images, and behaviour patterns that are represented in memory as nodes in an interconnected information network. It is assumed that these nodes are representations of concepts that are more closely or distantly linked depending on intrinsic meaning and learning history.

According to Anderson (1983), when this network is triggered by a relevant stimulus, memory activation spreads throughout the network and which nodes are activated reflects the level of association between concepts in memory. Higher-order concepts can then be constructed from coactivated nodes when various pertinent stimuli trigger the network (Goldman et al, 1999). It is important to note that spreading activation networks do not require effortful processing but rely on incoming stimuli being organised on the basis of previously stored information. Whenever stimuli that match previously encoded data are encountered, the relevant nodes are activated in a predictable fashion. Furthermore, when repetitions of a particular activation pattern (such as those associations activated during recurrent drug use) is
consistent and frequent enough, activation of those same patterns is facilitated under similar circumstances in the future (Hopfield & Tank, 1986; Murre, 1997).

### 2.2.2.1 Motivation in memory network activation

The pattern and content of alcohol-related memory activation in network models may have motivational implications for drinking (Stacy, 1995). Associative memory theory holds that cues and attitudes (enduring associations between attitude objects and related evaluations; Fazio, 1995) are represented in memory as knowledge units. Accessibility of related attitudinal information is increased whenever related internal or external drinking cues are encountered. Similarly when cues are encountered, the accessibility of alcohol use as a behavioural option is increased, biasing information available for behavioural decision making (Leigh & Stacy, 1998). Memory associations may include affective features or elements that motivate approach or avoidance behaviour when social or environmental correlates of affect are encountered (Rescorla, 1992; Stacy, 1995; Stacy, Widaman & Marlatt, 1990). Therefore, with repeated drinking experience, associative cues, behavioural outcomes and alcohol use may be automatically associated with the result that behavioural control systems become largely nonconscious in nature and influence behavioural responses implicitly (“in a fashion not introspectively known by the actor”; Greenwald & Banaji, 1995, p. 4; Merkle, Joordens & Stolz, 1995; Tiffany, 1990).

### 2.2.3 Integration and implications

According to memory association models described above, alcohol-related cognitions and behavioural outcomes (drinking) may become automatically associated with repeated drinking experience (Bolles, 1972; Oei & Baldwin, 1994; Tiffany, 1990). Furthermore, the automatic activation of drinking-related memory networks in response to cues is proposed to motivate alcohol use behaviour (Stacy, 1995). If such
cognitions are stored in an associative network together with related alcohol concepts, such as affective and physical cues and drinking behaviours, then activation of any one of these memory components should lead to increased accessibility of any or all of the others. By assessing associations between these information elements implicitly (i.e., without an individual’s awareness that the influence of past experiences on present responses are being considered: Greenwald & Banaji, 1995; Roediger, 1990) researchers could determine the accessibility of any alcohol-related material in memory. Consequently, several approaches have been taken to the assessment of alcohol-related cognitions using a range of implicit measures.

2.3 Measures of alcohol-related memory accessibility: A review of implicit cognitions research in undergraduates

2.3.1 Information processing and positive outcome-behaviour associations

One approach to the implicit assessment of accessibility of associations between alcohol-related information elements in memory has been developed using the outcome-behaviour association task (Stacy, Leigh, & Weingardt, 1994). Stacy and colleagues initially used an outcome-behaviour association measure to investigate the hypothesis that accessibility in memory for positive outcomes of drinking mediates concurrent alcohol use (Leigh & Stacy, 1998; Stacy et al., 1994). Participants in the study were presented with a questionnaire described as a “word association task”. The questionnaire comprised a list of phrases that stated positive consequences of consuming alcohol (generated in a preliminary study where participants were asked to list the good or pleasant things that happened to them when they drank alcohol) along with a similar number of outcomes not related to alcohol use. Participants were asked to fill in two blanks with the very first behaviour or action that came to mind when they read the phrases. Responses were coded as
alcohol or non alcohol-related. It was found that greater frequency of drinking was associated with greater numbers of alcohol-related behaviours generated on the memory association task (Leigh & Stacy, 1998; Stacy et al., 1994).

Palfai and Wood (2001) replicated this methodology and found that responses to the outcome association task were associated with measures of alcohol use frequency, heavy drinking and alcohol-related problems. Leigh and Stacy (1998) interpreted these findings as evidence that thoughts about positive outcomes of drinking, situational cues and alcohol consumption are associated in memory and may provide a priming mechanism to explain drinking behaviours. The extent to which these outcomes are associated with alcohol use will lead to facilitation of alcohol concepts in memory. Such activation may also limit accessibility for other, non alcohol-related concepts. In this way, drinking may become a highly accessible behavioural option for people with a higher number of positive alcohol-related outcome associations.

2.3.1.1 Positive and negative outcome associations

The studies mentioned above focussed only on positive outcomes of drinking. However, when researchers used an association task including positive and negative outcomes, they found that previous alcohol use predicted responses to negative as well as positive outcomes of drinking (e.g., Gadon, Bruce, McConnochie, & Jones, 2004). One recent study included the effect of situational context on the number of alcohol-related responses to an association task using both positive and negative outcomes (Wiers et al., 2003). Undergraduate drinkers (N = 50 for each condition) were approached for assessment in one of three contexts, neutral, pre-bar, and bar. The neutral context was a communal area used for casual study and socialising. The bar setting was a licensed on-campus pub, while the connecting walkway between the...
The communal area and the pub comprised the pre-bar context. The alcohol focus of the study was not revealed to participants. Effects of context on number of alcohol associations were found for negative but not positive outcomes, with participants reporting more alcohol-related responses in the bar and pre-bar context compared to the neutral context. The authors suggest that physical cues (smell, alcohol-related paraphernalia) present in the bar context but not in the neutral context contributed to activation of related memory networks leading to a facilitation of alcohol associations in memory.

The finding that both positive and negative outcomes were associated with increased drinking is consistent with a social learning perspective. Increases in consumption would naturally lead to increases in experience with negative outcomes. However, these findings provide an intuitive conundrum. If both positive and negative outcomes are positively associated with drinking, questions are raised about why heavy drinkers (who would experience more negative outcomes than light drinkers) continue to drink.

Memory accessibility models may account for the suggestion that positive outcomes might be predictive of consumption (Palfai & Wood, 2001; Stacy et al. 1994). However, mechanisms of expected positive reinforcement are not so readily applied to the role of negative outcomes. Some researchers have suggested that the relative importance of positive and negative outcomes is explained by the biphasic behavioural properties of alcohol (Leigh, 1989b; Stacy et al., 1990). That is, the immediate effects of alcohol consumption are positive, whereas the delayed effects are negative (see Section 1.4.2). Leigh and Stacy (1998) suggest that a combination of two learning processes, the immediacy assumption and the encoding specificity
principle may help to explain the apparent separation of accessibility for positive and negative outcomes.

The immediacy assumption is based on the idea that delays in reinforcement lead to a weakened stimulus–response association in memory. It has been argued that because many of the positive outcomes of drinking (and other addictive behaviours) are more immediate than negative outcomes, they will be reinforced sooner, and so more strongly associated with initial cues. The delay in experience of any negative outcomes will act to weaken the association with drinking cues (Bandura, 1969; Marlatt, 1985; Miller, 1984). In support of the immediacy assumption, Leigh, Stacy, and Arambaru (1989) found that outcomes drinkers labelled as positive occurred sooner after starting to drink than those they labelled as negative.

In addition to the behavioural interpretation of the immediacy assumption, the encoding specificity principle is a well-supported cognitive principle that recall is improved when retrieval situations are similar and compatible with encoding situations (for a review, see Tulving, 1983). According to the encoding specificity principle, similarities in cues between earlier encoding situations and later retrieval situations should lead to easier retrieval and according to the immediacy assumption; positive outcomes are more likely to have been encoded in the initial phase of drinking. Thus, taken together, situational and affective cues for drinking should lead to enhanced accessibility of positive outcomes from memory when those situations are again encountered. Through these two mechanisms, alcohol-related cues would facilitate accessibility for more immediate positive outcomes, and negative outcomes would not be as readily available in memory. In this way, an individual may hold strong memory associations between negative outcomes and alcohol consumption,
without them having any motivational effects in real-life situations (Stacy et al., 1990).

Research reviewed thus far using outcome-association tasks to assess accessibility for drinking outcomes supports the idea that alcohol-related cognitions can be activated automatically in memory in response to outcome phrases (e.g., Leigh & Stacy, 1998; Palfai & Wood, 2001; Stacy et al., 1994). These findings were particularly salient, as respondents were unaware that they were being tested for alcohol-related outcomes.

2.3.2 Accessibility and ambiguous cue-associations

Free associations to ambiguous alcohol-related cues have also been found to be predictive of drinking (e.g., Stacy, 1995). A central assumption of associative memory theory is that associative responses to the objects, words, and events that frequently accompany alcohol use will also tap into memory associations that include motivation and affect (see Section 2.2.2.1). In this way, memory associations made to ambiguous alcohol-related cues should be predictive of consumption.

Free associations to ambiguous drug cues have been previously investigated using a cue-association paradigm (Stacy, 1995). In this paradigm, participants are presented with a list of words or pictures of objects potentially related to alcohol use. These stimuli are intermixed with a number of other ambiguous words or pictures not likely to be related to drinking. Participants are instructed to write down next to each word or picture the first word that comes to mind and responses are coded for drug-related references. The derived measure of associative strength (number of alcohol-related responses) has been found to predict concurrent alcohol use among students, and these effects were independent of potentially confounding background variables.
including acculturation, socioeconomic status, peer use, and parental use (Stacy, 1995).

Stacy (1997) subsequently used structural equation modelling to examine the fit of two independent prospective models for alcohol and marijuana use in a college student sample. Both models contained previous alcohol/marijuana use, memory activation, outcome expectancy, impulsive sensation seeking, and control variables including acculturation and gender. The latent dependent variables (alcohol/marijuana use) were measured one month after the initial assessment. For the alcohol use model, results showed that implicit memory associations predicted later drinking after controlling for previous drinking. Sensation seeking and explicit expectancy measures predicted subsequent alcohol use independently. Furthermore, memory associations were better predictors of future drinking ($\beta = .33$) than the outcome expectancy questionnaires ($\beta = .09$). Acculturation and gender did not add to model fit. Stacy concluded that measures of alcohol-related memory associations reflect memory activation patterns that are consistent with alcohol use and act to influence thoughts, interpretations, and behavioural options.

2.3.3 Memory networks and speed of processing

Automaticity of processing in memory network activation is central to cognitive explanations of drinking behaviours (Tiffany, 1990). A corollary to the idea that processing of alcohol-related concepts in memory becomes more automatic with repeated drinking experience (see Section 2.2.1) is that they are also assumed to increase in processing speed (McNamara, 1992; Tiffany, 1990). That is, the stronger the association between concepts in the memory network, the greater the automaticity and the less time needed for processing (Collins & Quillan, 1969). In this view, accessibility may be conceptualised as the ease or speed with which stored memory
facilitates information processing. A commonly used procedure in the cognitive literature that relies on such a conceptualisation to assess levels of association in memory networks is the implicit priming paradigm. In this paradigm, faster response times to a target item following exposure to a conceptually related prime shows associations between the prime and target concepts in memory (Meyer & Schvaneveldt, 1971). Importantly, priming effects are typically inferred from differences in response time of less than 100 milliseconds and such small time differences are held to reflect effortless, automatic processing that is not amenable to conscious, strategic control (McNamara, 1992). Thus, responses to this paradigm may reflect implicit memory activation that is relatively uncontaminated by explicit introspection or decision making processes.

2.3.3.1 Priming and response latency research

Researchers have adapted implicit priming paradigms to assess associative memory networks related to alcohol use (e.g., Weingardt, Stacy, & Leigh, 1996; Roerich & Goldman, 1995). Using response latency to alcohol-related target words, Weingardt et al. tested the effects of priming on 71 undergraduates using incomplete sentences as implicit primes describing either positive outcomes of drinking (e.g., “they loosened up when they were …”) or neutral word strings (e.g., “they said it was the…” ). Sentence primes were briefly presented on a computer screen followed by a single target word related to alcohol use objects or behaviours (e.g., wine, high). Participants were required to name the word out loud as soon as it was presented. It was found that for heavier drinkers, responses to target words were facilitated by priming of positive expectancies. The authors suggest that when thoughts about potentially positive outcomes of drinking are cued, concepts related to alcohol use become more accessible in memory, especially among participants with extensive
alcohol experience. This increased accessibility may have motivational salience through biasing of behavioural decisions toward consumption.

Another methodology using a response latency procedure to assess the accessibility of alcohol-related cognitions has been adapted from related research on attitude (Fazio et al. 1986; Houston & Fazio, 1989). Fazio and colleagues reported that self-rated attitudes are more predictive of actual behaviour when those attitudes are more accessible in memory, as measured by latency of response to attitude inquiries. Accordingly, measures of processing speed from attitude research have been adapted to assess memory accessibility for the expected effects of alcohol.

Palfai, Monti, Colby, and Rohsenow (1997) used response latency as a primary dependent measure to investigate the effects of suppressing the urge to drink on speed of processing for alcohol expectancies among undergraduates. Palfai et al. measured response latency using a computer task that consisted of responding to a series of stimuli by pressing one of two buttons marked either ‘yes’ or ‘no’ on a computer keyboard. The stimuli consisted of 36 alcohol expectancy words and 36 personality trait words. Personality trait words were used as filler items to control for individual differences in response speed on the alcohol expectancy items. The words were preceded by one of two prompts, “I am generally” or “Alcohol makes me” which were shown for two seconds, followed by the target word.

After being exposed to alcohol cues (lifting a glass full of beverage and sniffing it) half the participants were asked to suppress their urge to drink while the other half were given no instructions. Participants were then asked to complete a series of 12 trials on the response latency task before completing the task as quickly as possible while remaining accurate in their responses. Palfai et al. (1997) found that participants who were told to suppress their cravings to drink made significantly faster
alcohol expectancy judgements in response to prompts than did those who were given no instruction. The authors concluded that suppression of the urge to drink might prime alcohol-related associations in memory leading to increased accessibility of alcohol-related cognitions.

A more recent study used response latency to alcohol-related evaluative judgements to prospectively predict alcohol use in 139 university students (Kelly & Witkiewitz, 2003). It was found that response latency at Time 1 for tension reduction and cognitive impairment domains of the DEQ (Young & Knight, 1989) predicted drinking four months later. Importantly, findings remained significant after accounting for autocorrelations in alcohol use. Results suggest that speed of processing (i.e., chronic accessibility) of implicit alcohol-related attitudes predicts later drinking in undergraduates.

2.3.4 Implicit association tests

Investigations of novel implicit response latency paradigms have included research using the Implicit Associations Test (IAT; Greenwald, McGhee, & Jordan, 1998). Greenwald and Banaji (1995) describe implicit attitudes as being evaluations that are activated automatically and made manifest as actions or judgements without the individual’s conscious awareness of the automatic control processes. The IAT measures this underlying automatic evaluation of implicit attitudes and is therefore similar to priming methods previously used to measure automatic attitude (e.g., Fazio, Sabonmatsu, Powell, & Kardes, 1986; Fazio, 1990). The IAT is essentially a categorisation task that measures differential association of two target concepts with an attribute. As such it offers a method for indirectly assessing the relative strength of associations between concepts.
In the IAT, two target concepts (e.g., flowers and insects) along with two evaluation attribute words (e.g., pleasant and unpleasant) are presented on a computer screen. In one trial, participants are obliged to respond to more highly associated categories (e.g., flowers and pleasant words; insects and unpleasant words) with the same key. In another trial, participants must respond to less associated categories (e.g., insects and pleasant words; flowers and unpleasant words) with the same key. Reaction times are facilitated when more associated concepts share the same key. The difference in performance between the two trials is called the “IAT effect” and is an implicit measure of the differential association between the two categories (concepts) with the attribute.

Two studies have recently adapted the IAT to measure associations between alcohol use and alcohol-related cognitions (Jajodia & Earlywine, 2003; Wiers, Woerden, Smulders & De Jong, 2002). Wiers et al. investigated IAT effects among 24 light drinkers and 24 heavy drinkers from an undergraduate sample. Differential association of alcohol-related words (e.g., beer, whisky, vodka) to positive expectancy words (sociable, pleasant, relaxed) or negative expectancy words (e.g., noisy, obnoxious, angry) were assessed using non-alcoholic drinks (e.g., coke, juice, soda) as the contrast category to alcohol. No differences in reaction times were found between light and heavy drinkers in trials where alcohol words and positive evaluations were mapped to the same response key compared to trials that paired alcohol and negative evaluations. Overall, both light and heavy drinkers showed more negative evaluations to alcoholic drinks compared to the non-alcoholic category.

In the second study of interest (Jajodia & Earlywine, 2003), positive and negative expectancy words were compared to neutral words (e.g., closing, stationary, digital) in two separate IAT paradigms. The contrast category to alcoholic drinks in
both tests was mammals (e.g., dolphin, whale, sheep). One hundred and three undergraduates (40% male) completed both IAT tasks. In contrast to Wiers et al. (2002), hierarchical regression analysis revealed that reaction times to positive implicit associations were predictive of alcohol use while negative associations were not. While early results using the IAT are equivocal, these studies provide initial evidence that IAT measures of memory associations to alcohol concepts are related to drinking.

2.3.5 Experimental manipulations: Implicit priming and later drinking

Implicit activation of alcohol-related memory networks in experimental settings has also been found to affect later consumption (e.g., Roehrich & Goldman, 1995; Stein, Goldman, & Del Boca, 2000). Manipulating alcohol-related memory implicitly and observing a change in drinking might better demonstrate a causal effect of expectancy concepts on consumption (see Section 1.6). Roehrich and Goldman initially primed positive outcome or neutral words using a modified Stroop paradigm (see MacLeod 1991). Words coloured red, blue, and green were presented on slides and participants were asked to ignore the semantic content (positive or neutral drinking outcomes) and name the colour of the word as quickly as possible.

Participants were exposed to three example slides, nine interference slides, and seven priming slides in each experimental condition. Each of the seven priming words was presented three times, each time as a different colour. To ensure that priming remained implicit, the priming phase and later consumption phase of the experiment were presented as two separate, unrelated studies. Results showed that ad libitum drinking was significantly higher among those participants primed with positive outcome words compared to those primed with neutral words.
A later study extended this research by using a different priming paradigm followed by a manipulation check to assess whether participants had assimilated the alcohol-related information into memory (Stein et al., 2000). In the priming phase, participants were presented with a list of 15 stimulus words (positive outcomes of drinking or neutral) and were asked to provide synonyms on a blank line next to each word. To check semantic processing of the word primes, the 15 target items were embedded in a list of 45 control words and participants rated how confident they were that they had seen/not seen the word in the priming list. In both the positive and neutral conditions, participants showed high recognition accuracy, inferring that semantic processing of the primed words had occurred. Alcohol consumption then took place; ostensibly as part of a separate “consumer survey” study. Results indicated that alcohol consumption was greater among participants in the positive outcome manipulation condition compared to the neutral condition.

One study has explored the effects of both positive and negative primes on ad-libitum consumption (Carter, McNair, Corbin, & Black, 1998). Sixty-four undergraduates (38 female and 26 male) who were regular drinkers were randomly assigned to 1 of 3 priming conditions: a positive expectancy outcome condition, a negative expectancy outcome condition, and a neutral (control) condition. The priming task was a replication of the modified Stroop colour–word paradigm procedure used by Roehrich and Goldman (1995). Positive expectancy priming words (e.g., happy, horny, relaxed) and negative expectancy priming words (e.g., clumsy, slow, problem) were chosen on the basis of prior research using multidimensional scaling techniques to map models of the organisation of alcohol expectancy concepts in memory (Goldman & Rather, 1993). The neutral condition included seven words that matched the positive/negative condition on the first letter of each word (e.g.,
hammer, highway, river). To obtain a measure of ad-libitum alcohol consumption following the priming task, participants were given 15 minutes to rate the tastes of three non-alcoholic beers in a separate “taste challenge”. Analyses revealed that greater alcohol consumption occurred in the positive expectancy prime group compared to the control group. Implicit manipulation of positive outcome concepts may lead to changes in immediate alcohol consumption in experimental settings. These findings also offer some evidence for a causal role of implicit alcohol-related cognitions in drinking.

2.3.6 Summary and integration

In keeping with associative memory models, various measures of alcohol-related implicit cognitions have assisted researchers in substantiating underlying cognitive mechanisms of expectancies. Evidence from studies of response latency to various implicit alcohol primes suggests that alcohol-related concepts can be activated implicitly and that measures of such implicit cognitive processes are predictive of drinking (Gadon et al., 2004; Kelly & Witkiewitz, 2003; Palfai et al., 1997). Similarly, studies of the effects of implicit primes on later consumption suggest that, at least in the short term, implicit manipulation of alcohol-related cognitions using stimuli from empirically derived models of memory processes can influence alcohol use. In addition, the effect of priming on ad-libitum drinking provides further evidence for the assumption of a causal relationship between alcohol-related cognitions and the early phases of alcohol consumption (Stein et al., 2000). Finally, accessibility of associations between drinking and its positive and negative outcomes and between drinking and ambiguous cues has been predictive of concurrent and later alcohol use (Stacy, 1995; 1997).

2.4 Limitations to implicit cognitions research
Although sound evidence for the utility of chronic accessibility of alcohol-related memory to predict drinking in undergraduate populations has been presented, some limitations to extant research exist. To begin with, several studies (e.g., Stacy, 1995; 1997; Stacy et al., 1994) show that responses to outcome-behaviour and cue-association memory tasks predicts composite quantity/frequency/intoxication indices of alcohol consumption. However, evidence of associations between accessibility and global measures of drinking has limited public health or clinical meaning. Such findings give little guide as to the role of accessibility in discriminating different patterns of drinking. For example, it is unclear whether memory accessibility is differentially related to initiation of drinking (i.e., frequency of use) compared to continuation of a drinking episode (i.e., quantity consumed) among undergraduate drinkers. Further research investigating mediational pathways between accessibility and quantity/frequency dimensions of drinking could contribute to a better understanding of the complex role of implicit memory processes in drinking behaviour and inform about possible relationships between accessibility and problematic drinking.

Only one study has examined prospective relationships between free associations to ambiguous alcohol-related cues and drinking (Stacy, 1997; see Section 2.3.6). Although results showed that Time 1 memory associations predicted Time 2 drinking after controlling for previous drinking, longitudinal models were limited to two waves of data and alcohol consumption and memory accessibility were not measured at each time point (memory accessibility measures were administered at Time 1 only). The value of previous longitudinal analyses would be enhanced by incorporating measures of drinking and memory accessibility at each of three or more
waves of data. This could better account for any variability in change of accessibility and alcohol consumption over time.

2.5 Conclusions

There are sound theoretical reasons for conceptualizing the mechanisms of alcohol expectancies in terms of network models of memory processes. Supporting evidence from studies of implicit measures predicated on this approach suggests that activation of alcohol-related concepts in memory may influence drinking behaviour. In order to improve existing models of alcohol use, further longitudinal research is required to account for competing hypotheses prospectively, as is exploration of the effects of chronic accessibility of alcohol-related implicit cognitions on different dimensions of drinking.
CHAPTER THREE

Mediating mechanisms in the relation of chronic accessibility of alcohol-related memory to quantity and frequency dimensions of undergraduate drinking
3.1 Introduction

Researchers of alcohol use have recently drawn on associative memory theory (see Section 2.2.2) to account for drug-taking behaviour and how it evolves over time (Kelly & Witkiewitz, 2003; Palfai & Wood, 2001; Stacy, 1995). According to associative memory models of alcohol use, accessibility of associations in memory between alcohol-related cues and alcohol use may have motivational implications (Stacy, 1995; see Section 2.3.6). Previous research has shown that number of alcohol-related responses to cue-association tasks may be useful memory association correlates of drinking behaviours (Ames et al., 2002; Stacy, 1995; 1997). Although studies show that alcohol-related accessibility predicts composite indices of alcohol consumption, these indices do not explain important variability in undergraduate drinking patterns (see Sections 1.5.3 & 2.4). Research has yet to investigate the relationships between accessibility and quantity/frequency dimensions of drinking behaviour.

It would be reasonable to expect that accessibility for alcohol-related associations and frequency of drinking sessions would be related. According to associative memory models, repetition of drinking initiation should strengthen associations in memory between antecedent and consequent events (Oei & Baldwin, 1994; see Section 2.2.1). For people with chronic accessibility of alcohol-related associations, the likelihood of these associations occurring in response to ambiguous cues should be high, with a concomitant increase in the likelihood of drinking initiation (Ames, Zogg, & Stacy, 2002). Once drinking has begun however, alcohol-related accessibility (as operationalised by Stacy, 1995; 1997) should be less related to amount consumed per session than the number of drinking sessions. Assuming that alcohol constructs are readily accessible and available when drinking is occurring,
continued consumption would seem more likely to be related to explicit contextual
cues (drinking venues, alcohol-related paraphernalia) and the psychopharmacological
effects of ethanol rather than accessibility. This is not to suggest that implicit memory
processes no longer play a role in ongoing consumption. For example, the mood-
altering properties of alcohol may facilitate implicit processes that drive on-line
drinking via state-dependent learning (Bower, 1995). However, in the present study I
was interested in the role of accessibility to predict drinking in a non-drinking context.
Once drinking has begun, ongoing consumption may be a result of a number of
processes and associations to ambiguous cues in a non-drinking context may have
limited utility. Thus, it was expected there would be a closer association between
accessibility and drinking initiation than quantity consumed.

Although the effects of ethanol ingestion on free associations to ambiguous
verbal cues are under researched, at least one study has shown that chronic
accessibility may be altered by alcohol consumption (Sayette, Martin, Perrott, &
Wertz, 2001). In this study, the influence of alcohol on spreading memory activation
was tested using a semantic priming task. Twenty-three semantically indirectly related
(e.g., “lion” indirectly related to “stripes” via “tiger”) and unrelated word pairs were
presented sequentially on a computer monitor. Participants were asked to read the
first word and then to name out loud the target word. After drinking alcohol or a
placebo beverage, it was found that the alcohol consumption group showed
significantly reduced priming effects for indirectly associated targets. This finding
suggests that alcohol may limit cognitive capacity by constraining the spread of
activation of associated information in memory. Given that such memory activation is
central to the proposed motivational implications of accessibility (see Section 2.2.2.1).
Alcohol-related constraints on memory activation may mean that decisions to
continue drinking would be less likely to be influenced by accessibility than decisions to initiate a drinking session. Therefore, it was predicted in the present study that any significant relationship between accessibility and heavy drinking would be mediated by the frequency of drinking sessions.

A competing explanation for the association between alcohol-related memory network activation and drinking is sensation seeking. Sensation seeking may be best described as a biologically based personality trait that predisposes individuals to a need for stimulation (Zuckerman, 1993; 1994). In a review of personality correlates of college student drinking it was found that a personality dimension of impulsive sensation seeking was associated with greater drinking and negatives consequences in 20 studies (Brennan, Walfish, & Aubuchon, 1986). Memory associations about the positive outcomes of alcohol consumption may be confounded with the heightened sensitivity to reinforcement that is the central characteristic of sensation seeking (Stacy, 1997). Those higher in sensation seeking may be more susceptible to the rewarding effects of drug use (Cloniger, 1994), and sensation seeking has been shown to predict alcohol use (Donohew et al., 1999; Newcombe & McGee, 1991; Stacy, Newcomb, & Bentler, 1993; Stacy, 1997). In the present study it was proposed that sensation seeking would have a direct effect on frequency of drinking and heavy drinking.

Finally, age and gender were included in the cross-sectional model to investigate differences that these variables may have on heavy drinking. It was expected that age would have direct effects on both frequency and heavy drinking. Older participants should drink less frequently and not as heavily as younger participants (Australian Institute of Health and Welfare: AIHW, 1999; Fillmore, Hartka, Johnstone, Leino, et al., 1991; see Section 1.3). In contrast, gender was
thought to directly influence heavy drinking but not frequency of drinking. In a recent survey of 14,762 Australian women aged 18 to 23 years it was found that 94% were regular drinkers, indicating that among young people in Australia, females may drink just as often as males (Jonas, Dobson, & Brown, 2000). However, young males continue to consume alcohol at risky levels more frequently than do females (AIHW, 1999).

The present study used a cue-association paradigm to examine the relation of alcohol-related associative strength to drinking frequency and heavy drinking. Predictions were tested using a sample of first year Australian university students. The legal drinking age in Australia is 18 years, and this “coming of age” usually coincides with university entry. Among Australian university students, variability in alcohol use is high and may range from abstinence (6%) to binge drinking weekly or more often (46%) (Roche & Watt, 1999; see Section 1.2).

Prior to conducting the central analyses (Study 2), existing cue-association measures were first refined to better suit Australian samples. Paradigms validated in earlier studies (e.g., Stacy, 1997) could be poor memory association correlates of drinking behaviours in Australian undergraduates because of cross-cultural variation in alcohol-related referents. Given initial evidence for the utility of this measurement paradigm, a logical next step would be to investigate methods of refinement to improve the predictive power of cue-association tasks. It is likely that choice of target referents may significantly affect the utility of cue-association tasks in predicting drinking behaviours. Refinement is a first step in optimising memory association measures.

A factor likely to impact on response patterns to target words in association tasks and hence the role of target items in predicting drinking may be found in the set
size effect (see Nelson, Schreiber, & McEvoy, 1992). Studies of cued recall have indicated that words may be associated in memory with varying numbers of other words (Nelson, Bennett, Gee, Schrieber, & McEvoy, 1993). The number of associates a word has in memory is called set size and the target set size effect refers to the robust finding that words with fewer associates are recalled better and more quickly than those with a larger number of associates. This effect has been found for both unambiguous and ambiguous words (Nelson et al., 1992; Gee, 1997).

A model consistent with associative memory theory (Processing Implicit and Explicit Representations, PIER; Nelson et al., 1992), describes the set size effect as a result of competition at retrieval. In this model, representations activated implicitly by a cue word are searched in memory by sampling cue associations. Words with many activated associates are less likely to be sampled compared to words with few activated associates (Gee, 1997). Accordingly, free memory associations made to ambiguous words may also exhibit effects related to set size. When associations are made to ambiguous words with a smaller set size (i.e., fewer numbers of related associates), increased activation and hence accessibility of those associates should occur compared to words with a larger set size. If an ambiguous cue has alcohol use as part of its associative set, it might be expected that cues with a small set size (i.e., limited in associates to alcohol use and only one or two other outcomes) would be more likely to elicit an alcohol-related response than ambiguous cues with a larger number of associates. According to associative memory theory, repeated drinking

\[1\] Given that researchers typically establish the set size for an individual word by asking respondents to make free associations (i.e., the first response that comes to mind) to a given word and then count the frequency of different responses given by two or more participants (Nelson & Schrieber, 1992). Viewed from this perspective, the cue association task performs a similar function.
experience facilitates accessibility of alcohol-related memory associations in the presence of ambiguous cues. The set size effect may further enhance the likelihood of an alcohol-related response for ambiguous words with a smaller set size. In this way, some ambiguous word cues may be better associated with alcohol use than others.

Therefore, in Study 1, a preliminary list of potentially alcohol-related cue words with an established likelihood of association with alcohol use was generated. This list was then refined to optimise the predictive power of the cue-association task.

3.2 Study 1 – Paradigm modification and validation

3.2.1 Method

3.2.1.1 Participants

A total sample of 325 Australian undergraduate university students participated in this study as part of an introductory statistics course that encompasses students from a number of degree programs. Study 1 had two Phases, in Phase 1 (item generation) 157 students participated for course credit. The sample comprised 111 females and 46 males with a mean age of 22 years (SD = 6.33). Ninety-two percent of participants indicated that they had consumed alcohol over the past month.

In Phase 2 (psychometric validation), a further 168 (52 male and 116 female) participated and these participants were rewarded by inclusion in a lottery with first, second, and third prize totalling AUD $300. Participants’ age ranged from 18 to 54 years with a mean age of 22 years (SD = 6.26). About a quarter of participants (23%) indicated that English was their second language. The majority of participants were current drinkers (91%) who indicated that they drank at least monthly. The remaining 9% identified themselves as current abstainers.
3.2.1.2 Measures and Procedure

In Phase 1 (item generation), following informed consent, participants \((n = 157)\) completed a target item validation task where they rated the degree to which they associated a list of alcohol and non-alcohol-related words with alcohol use on a 10-point Likert scale (range 0 ‘not at all associated’ to 10 ‘highly associated’). This was designed to generate a set of word cues that would produce a reasonable frequency of alcohol-related responses on the cue-association task in Phase 2. Only those alcohol-related homographs that received a mean Likert scale rating of greater than 5 ‘somewhat associated’ were selected. Homographs that met this criterion were nip, swig, can, jug, port, shot, glass, cask, bar, and pub.

In Phase 2 (psychometric validation), the 10 ambiguous homographs identified in Phase 1 were randomly split into two lists of five homographs (list A: jug, shot, glass, can, nip; List B: cask, pub, port, bar, swig). Each 5-item list was intermixed with 33 other homographs not likely to be related to drinking (e.g., field, knit, stair). Each list was then randomly scrambled to produce a questionnaire with four different permutations, with the constraint that any alcohol-related words were separated by at least three filler items. Words used in the association tasks were single syllable words of high frequency (above 20 per million; Kucera & Francis, 1967). Participants \((n = 168)\) were instructed that the questionnaire was anonymous and was concerned with automatic perceptions and health-related behaviours. There was no explicit reference to alcohol in the instructional set. Following informed consent, questionnaires were administered in groups of between 30 and 50 individuals.

Participants were instructed to complete the questionnaire under exam conditions and not to turn ahead in the booklet until they had completed the page that they were on. The participants were told: “For the first questions, you will be asked to
write single words that immediately come to mind in response to other words. For these types of questions, please respond with the very first word that comes to mind, whatever it is. Remember your answers are totally anonymous, and there are no right or wrong answers. Write next to each word the first word it makes you think of. For example, if the word is doctor, you might write ‘nurse’. Work quickly!” (Stacy, 1997, p. 64).

After completing the cue-association task, participants then completed the Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, de la Fuente, & Grant, 1993). The AUDIT is a 10-item self-report measure of alcohol-related risk with demonstrated validity and reliability among college students (Fleming, Barry, & MacDonald, 1991). Alcohol use was assessed using the first three questions from the AUDIT, which is a valid measure of quantity and frequency of alcohol consumption and frequency of heavy episodic drinking among college students (Fleming et al., 1991) and adolescents (Knight, Sherritt, Harris, Gates, & Chang, 2003). Each of the three questions was scored from 0 to 4 giving a possible maximum summed score of 12. Three derived measures of alcohol use were calculated based on AUDIT responses: (i) Average alcohol consumption (calculated by summing scores 0 to 4 on AUDIT items 1 and 2); (ii) Heavy episodic drinking (AUDIT item 3); and (iii) Total AUDIT score.

The task order in Phase 2 was designed to preserve the integrity of the cue-association task by ensuring that the risk of alcohol-related priming was minimised. Two coded responses on the cue association task according to alcohol-related references from a master list of reference words agreed upon by the researcher and the research assistants as unambiguously related to alcohol or alcohol consumption. This list was conservative – words like ‘drink’ were not coded as alcohol-related.
3.2.2 Results

3.2.2.1 Target item validation

In Phase 2, 165 participants (98.2% of the sample) provided at least one alcohol-related response to the ambiguous alcohol-related homographs. Thirteen (7.7%) made 1 response, 17 (10.1%) made 2 responses, 49 (29.2%) made 3 responses, 50 (29.8%) made 4 responses, 26 (15.5%) made 5 responses, 9 (5.4%) made 6 responses, and 1 (0.6%) made 7 alcohol-related responses. There were no alcohol-related responses made to any of the filler items in the memory association tasks.

Participants reported a mean average alcohol consumption of 3.18 (SD = 1.78) from a possible summed score of 8 from AUDIT items 1 and 2. Mean scores for heavy episodic drinking were 1.36 (SD = 1.10) from a possible total of 3. Participants reported a mean Total AUDIT score of 8.37 (SD = 6.15) with a range of 0 – 28. Sixty participants (36% of the sample) reported drinking at hazardous levels (M = 15.15, SD = 3.83), based on a cut off point of 11 (Fleming et al., 1991). The remaining 108 (64%) fell in the non-hazardous category (M = 4.60, SD =3.28).

The aim of Phase 2 was to identify those ambiguous word cues from the two association tasks that were clearly unassociated with alcohol use. These could then be culled from the cue-association measure and the remaining ambiguous words tested for their utility to predict alcohol use. Because there were no alcohol-related responses made to any of the filler items in the memory association tasks, only the 10 target words were included in the following analysis. To cull homographs unlikely to be related to drinking, AUDIT Total scores were regressed on responses to all 10 ambiguous alcohol-related homographs (coded either 0 ‘nonalcohol-related’ or 1 ‘alcohol-related’) providing a binary variable suitable for use in regression analysis. The value of the multiple correlation was moderate as expected (R = .33), but
significant, $F(10, 152) = 1.92, p < .05$). Target items were arranged in order of importance based on values of the squared semi-partial correlations. These values can be used to indicate the unique contribution of each independent variable to explaining variance in the dependent variable (Howell, 1997). The squared semi-partial correlations were less than .01 for glass, can, pub, swig, and bar and these items were culled from the 10 words identified in Phase 1.

The relationship between the remaining five homographs and drinking was further investigated using logistic regression. In this analysis the model with the constant plus predictor for each word was compared against the constant only model. The reliability of the difference between the log-likelihood of the models is given as chi-square values. AUDIT scores predicted alcohol-related responses for the homographs port and cask, $\chi^2(1, 168) = 6.371$ and $6.058, p < .05$ respectively. AUDIT total showed a trend toward significant prediction of alcohol-related responses for shot, nip, and jug ($p < .1$). To obtain an overall measure of alcohol-related associative strength, the sum of alcohol-related responses to the five words was used (range 0-5), justifying this on the basis that item-total correlations for these homographs were relatively similar (range .12 - .22). Previous studies using this paradigm (e.g., Stacy, 1997) have typically included five target words to assess implicit alcohol-related associations. This choice provides a reasonable number of target items while maintaining the ambiguity of the task.

Two separate hierarchical multiple regressions were conducted to evaluate the extent to which the derived measure of alcohol-related associative strength predicted AUDIT subscale scores of average consumption and heavy episodic use. This method was used to examine the hypothesis that the number of alcohol-related associations made to the five selected cue words has unique predictive utility for alcohol use over
and above that of the excluded cue words and relevant demographic variables. Gender was entered on Step 1, age on Step 2, alcohol-related responses for the five excluded ambiguous homographs on Step 3, and the derived measure of alcohol accessibility on Step 4 (see Table 3.1).

Table 3.1

Hierarchical Regression of Gender, Age, Excluded Cue Items and Remaining Cue Items on Average Consumption and Heavy Episodic Drinking (N = 168).

<table>
<thead>
<tr>
<th>Variables</th>
<th>R^2</th>
<th>R^2 Change</th>
<th>F Change Value</th>
<th>dfs</th>
<th>Beta</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average Consumption</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 1. Gender</td>
<td>.00</td>
<td>.00</td>
<td>.48</td>
<td>166</td>
<td>.05</td>
</tr>
<tr>
<td>Step 2. Age</td>
<td>.07</td>
<td>.07</td>
<td>11.56***</td>
<td>165</td>
<td>-.26***</td>
</tr>
<tr>
<td>Step 3. Excluded Cue Items</td>
<td>.08</td>
<td>.00</td>
<td>1.15</td>
<td>164</td>
<td>.08</td>
</tr>
<tr>
<td>Step 4. Remaining Cue Items</td>
<td>.18</td>
<td>.11</td>
<td>21.53****</td>
<td>163</td>
<td>.34****</td>
</tr>
<tr>
<td><strong>Heavy Episodic Drinking</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 1. Gender</td>
<td>.03</td>
<td>.03</td>
<td>5.86*</td>
<td>166</td>
<td>.19*</td>
</tr>
<tr>
<td>Step 2. Age</td>
<td>.08</td>
<td>.04</td>
<td>7.54**</td>
<td>165</td>
<td>-.21**</td>
</tr>
<tr>
<td>Step 3. Excluded Cue Items</td>
<td>.08</td>
<td>.01</td>
<td>1.12</td>
<td>164</td>
<td>.08</td>
</tr>
<tr>
<td>Step 4. Remaining Cue Items</td>
<td>.18</td>
<td>.09</td>
<td>18.19****</td>
<td>163</td>
<td>.31****</td>
</tr>
</tbody>
</table>

**Notes.** Beta values are standardised regression coefficients taken from each step in the model. * p < .05. ** p < .01. *** p < .001. **** p < .0001
The overall model accounted for 18% of the variance in average consumption, \( F(4, 163) = 9.10, p < .0001 \), and heavy episodic drinking scores, \( F(4, 163) = 8.62, p < .001 \). Compared to females, males were more likely to report heavy episodic drinking but there were no gender differences on average drinking. Age was significantly and negatively associated with both average consumption and heavy episodic drinking. The sum of excluded cue items was not a significant predictor of either variable. The derived measure of alcohol-related accessibility significantly predicted average consumption (11% unique variance) and heavy episodic drinking (9% unique variance). This measure of alcohol-related implicit cognitions was subsequently used in mediational analyses reported later.

3.2.2.2 Set size effects

To investigate whether set size played a role in the choice of the five remaining cue items, all 10 target words were examined for frequencies of actual responses. Percentages of responses to the target words are presented in Table 3.2. Responses were divided into two areas of interest; (a) alcohol-related responses and (b) numbers of other semantically related response categories. Number of semantic categories was used as a measure of set size to be consistent with the indicator of memory associations as the total number of all alcohol-related responses. Idiosyncratic responses that were not semantically related or did not account for more than 5% of total responses were omitted because they are generally considered unreliable as estimates of set size (Nelson & Schreiber, 1992).
Table 3.2
Percentages of Alcohol-Related, Semantically Related, and Semantically Unrelated Responses to 10 Target Cue Words.

<table>
<thead>
<tr>
<th>Remaining cue items</th>
<th>Alcohol-related responses %</th>
<th>Semantically related response categories %</th>
<th>Unrelated responses %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shot</td>
<td>6.5</td>
<td>(gun) 80.4</td>
<td>13.1</td>
</tr>
<tr>
<td>Jug</td>
<td>11.9</td>
<td>(beverages) 66.6</td>
<td>21.5</td>
</tr>
<tr>
<td>Nip</td>
<td>29.8</td>
<td>(tuck) 12.5</td>
<td>40.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(bite) 17.3</td>
<td></td>
</tr>
<tr>
<td>Cask</td>
<td>74.4</td>
<td>-</td>
<td>25.6</td>
</tr>
<tr>
<td>Port</td>
<td>34.5</td>
<td>(ship) 51.8</td>
<td>13.7</td>
</tr>
<tr>
<td>Excluded cue items</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can</td>
<td>1.2</td>
<td>(food) 7.1</td>
<td>32.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(beverages) 35.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(opener) 11.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(do) 12.5</td>
<td></td>
</tr>
<tr>
<td>Glass</td>
<td>4.8</td>
<td>(beverages) 26.8</td>
<td>41.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(broken) 10.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(window) 8.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(house) 7.7</td>
<td></td>
</tr>
<tr>
<td>Pub</td>
<td>86.9</td>
<td>-</td>
<td>13.1</td>
</tr>
<tr>
<td>Bar</td>
<td>69.0</td>
<td>(chocolate) 7.8</td>
<td>23.2</td>
</tr>
<tr>
<td>Swig</td>
<td>29.2</td>
<td>(beverages) 22.6</td>
<td>48.2</td>
</tr>
</tbody>
</table>

Note. Semantically related categories included groups of related responses (e.g., beverages = all non-alcoholic drink responses; gun = dead, kill, rifle, gun, blood) and any single word responses that were not part of a group but accounted for more than 5% of responses (e.g., chocolate). Responses that did not account for more than 5% were included in the unrelated responses group.
Examination of response frequencies showed that the excluded items “glass” and “can” had small percentages of alcohol-related responses (1.2% and 4.8% respectively), but were each associated with an additional four categories of outcomes, suggesting a large set size for these words. In contrast, the remaining words “jug” and “shot” showed higher numbers of alcohol-related responses (6.5% and 11.9% respectively), and were restricted to a small set size of alcohol use and only one other response category. “Jug” was strongly associated with non-alcoholic beverages (66.6%), while “shot” was strongly associated to gun (80.4%). Responses to the remaining items “port” and “nip” show similar patterns. Associations to “port” were limited to either ship (51.8%) or alcohol use (34.5%) with 13.7% of unrelated responses. While “nip” elicited associations to alcohol use (29.8%) and only two other categories, tuck (12.8%) and bite (17.3%) with 40% of other, idiosyncratic responses.

At the other end of the continuum of set size may be words that are overwhelmingly associated with only a single behaviour or outcome. Excluded cue words, “pub” and “bar” may represent highly culturally accessible (e.g., popular media and communication) cues to alcohol use that elicit alcohol-related responses from most participants (86.9% and 69% respectively), even those that rarely or never drink. As a result of this overwhelming association, these cues were unrelated to experience with alcohol use.

Finally, items “swig” and “cask” do not appear to be adequately explained by set size effects. The cue item “swig” showed a small set size of alcohol use (29.2%) and only one other response category, beverages (22.6%), but remained unrelated to drinking behaviour. However, examination of items revealed that the exclusion of “swig” might have been a result of the coding criteria for alcohol-related responses. Coding data showed that a response of “drink” or “drinks” to “swig” was coded as
non alcohol-related. It is possible that many participants had alcoholic drinks in mind when responding in this way, suggesting that “swig” may have been incorrectly categorised. However, it is not possible for coders to know this, and the most conservative coding option was taken. These problems with coding criteria argue that “swig” may not be a good choice as a target cue in future memory association tasks.

In contrast to “swig” the remaining cue item “cask” was related to drinking behaviour despite eliciting 74% alcohol-related responses and no other response categories. However, given that 69.7% of participants responded to “cask” with the word “wine”, perhaps not making an alcohol-related response to “cask” reflects inexperience with a particular type of alcohol use (drinking cask wine) that has been associated with heavy drinking (Grube & Nygaard, 2001).

3.3 Study 2 - Mediational modelling analysis

3.3.1 Participants

A further 214 first year undergraduates from the same university as Study 1 participated in this study. Participation in data collection was as part of a course requirement. There were 68 males and 146 females with a mean age of 20.6 years (SD = 4.7). Most participants (88.3%) indicated that they had drunk alcohol at least once in the last month. For the cue-association task, 189 participants (88.3%) recorded at least one alcohol-related response. Twenty-five participants (11.7% of the sample) did not make an alcohol-related response. Ninety-eight (45.8%) made one response, 56 (26.2%) made two responses, 29 (13.6%) made three responses, and 6 (3%) made four responses. Overall, the mean number of alcohol-related responses was 1.51 (SD = 0.96) from a possible range of 0 to 5. No significant differences in the number of alcohol-related responses were found for the four permuted forms, $F(3, 196) = 1.45$, $p > .05$. 
3.3.2 Measures

Alcohol-related memory associations were assessed using the cue-association task developed in Study 1. Sensation seeking was assessed using the Impulsive Sensation Seeking subscale of the Zuckerman-Kuhlman Personality Questionnaire (ISS; Zuckerman, Kuhlman, Thornquist, & Kiers, 1991). The ISS is a 19-item questionnaire with 8 items measuring impulsivity (e.g., “I tend to change interests frequently”) and 11 items measuring sensation seeking (e.g., “I like doing things just for the thrill of it”). The two scales show adequate intrascale reliability, test-retest reliability, and factor structure in university students (Stacy, 1997).

Because this sample was part of a longitudinal study of implicit cognition in the prediction of alcohol consumption, it was critical that participants were not aware of the purpose of the research. To measure drinking while preserving the integrity of the study, the Activities Checklist (see Appendix B) was developed in which the frequency and amount/duration of a range of health-related activities were measured over the previous month (e.g., exercise, study, relaxation). Two of 14 items related to alcohol consumption. For the first item participants recorded their responses to three questions: (1) “On average, how often do you have a drink containing alcohol?” (0 ‘never’ to 4 ‘four or more times per week’), (2) “What is the average number of drinks you have on a day when you are drinking?” (1-2, 3-4, 5-6, 7-9, 10 or more), and (3) “How often do you have six or more drinks on one occasion?” (never, less than monthly, monthly, weekly, daily or almost daily). The second alcohol-related item had the same questions but these related to their best friend’s use. To avoid detection of the alcohol focus of the study, three activities other than alcohol consumption had questions relating to best friend’s engagement in activities. Responses to the questions 1 and 2 (frequency and quantity) were scored from 0 to 4
and subsequently recoded to reflect consumption in number of drinks over the last month. The measures of alcohol use used were drinking frequency (recoded scores on question 1) and heavy drinking (question 3 only).

3.3.3 Procedure

Participants were informed that they were completing an anonymous survey described as an investigation of thoughts and attitudes about health related issues affecting undergraduates. As before, no mention of the alcohol-related focus of the study was made. After signing informed consent, surveys were administered individually in a quiet, air-conditioned room. Instructional set and coding procedures for both assessment times were identical to Study 1, Phase 2.

3.3.4 Results

To investigate the effects of alcohol-related associative strength, sensation seeking, age, and gender on quantity/frequency dimensions of alcohol use, structural equations modelling with manifest variables was conducted with AMOS 4 (Arbuckle, 1999). Maximum likelihood estimation was used as this procedure is considered relatively robust to non-normal distributions in model indicators (Bentler, 1990). Indices of fit used to evaluate models include the chi-square goodness-of-fit test, the comparative fit index (CFI), the Tucker-Lewis index (TLI), and the root mean square error of approximation (RMSEA). This range of indices is recommended to evaluate models because the chi-square goodness-of-fit test is sensitive to sample size (Stice, Schupak-Neuberg, Shaw, & Stein, 1994). Before conducting analysis, AAC and the age variable were subjected to logarithmic transformations to reduce skewness (Tabachnick & Fidell, 1999). Means, standard deviations and correlations for indicators in the model are presented in Table 3.3.
To assess whether frequency of drinking mediated the relationship between memory associations and heavy drinking, a chi-square difference test was used to check the relative fit of two nested, a priori models. The first model comprised the hypothesised pathways with memory associations affecting heavy drinking through frequency of drinking. In this model the direct pathway between memory associations and heavy drinking was constrained to zero. The second model was identical to the first except that it also included the direct pathway between memory associations and heavy drinking. If the predictions were correct, this additional path should be nonsignificant in the second model.

Analysis revealed that the first model was a relatively poor fit to the data, \( \chi^2 (6, N = 214) = 16.264, p = 0.012, \text{CFI} = .995, \text{TLI} = .983, \text{RMSEA} = .089. \) However, adding the direct pathway in the second model significantly improved the fit of the model, \( \chi^2 \text{difference} (2, N = 214) = 11.006, p = 0.001, \) and provided a good fit to the data, \( \chi^2 (5, N = 214) = 6.154, p = 0.292, \text{CFI} = 1.00, \text{TLI} = .998, \text{RMSEA} = .033. \) Figure 3.1 shows standardised path estimates and significance levels. All pathways were significant and the model accounted for 36% of the variance in heavy drinking.

While these findings do not support a full mediation hypothesis, significant indirect effects would indicate that the influence of accessibility on heavy drinking was partially mediated by frequency of drinking. To test the significance of the indirect effect, standard errors of parameter estimates were calculated using a 1000 replication bias-corrected bootstrap algorithm (Efron & Tibshirani, 1993; Shrout & Bolger, 2003). Results showed that the indirect effect of accessibility on heavy drinking was significant (\( \beta = .14, p < .001 \)), as partially mediated by frequency of drinking.
Table 3.3

Means, Standard Deviations and Correlations Among Model Indicators (N = 214).

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<tbody>
<tr>
<td>1. Memory Associations</td>
<td>-</td>
<td>1.50</td>
<td>0.96</td>
<td>0 - 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Drinking Frequency</td>
<td>0.32**</td>
<td>-</td>
<td>4.73</td>
<td>4.53</td>
<td>0 - 16</td>
<td></td>
<td></td>
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<tr>
<td>3. Heavy Drinking</td>
<td>0.33**</td>
<td>0.51**</td>
<td>-</td>
<td>1.44</td>
<td>1.04</td>
<td>0 - 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Sensation Seeking</td>
<td>0.05</td>
<td>0.12</td>
<td>0.25**</td>
<td>-</td>
<td>9.47</td>
<td>3.98</td>
<td>1 - 19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Age</td>
<td>0.12</td>
<td>0.20**</td>
<td>0.02</td>
<td>0.19**</td>
<td></td>
<td></td>
<td>20.63</td>
<td>4.67</td>
<td>17 - 36</td>
</tr>
<tr>
<td>6. Gender</td>
<td>0.01</td>
<td>0.05</td>
<td>0.12</td>
<td>0.12</td>
<td>0.06</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
</tbody>
</table>

Notes. * p < .05. ** p < .01.
Figure 3.1. Standardised model for memory accessibility, sensation seeking, age, gender, and heavy drinking. (* p < .05; ** p < .01; *** p < .001). E1 and E2 show error terms for endogenous variables.

3.4 Discussion

The primary aim of the present study was to refine cue-association task measures (Study 1) and assess relationships among alcohol-related accessibility, sensation seeking, age, gender, and quantity/frequency dimensions of alcohol consumption (Study 2).

3.4.1 Cue-association task refinement (Study1)

Results of the cue-association task refinement show that the five remaining target words elicited associative memory responses that were better predictors of both
average consumption and heavy episodic drinking than the excluded words. This finding suggests that choice of word cues in memory association tasks significantly affect the power of the task to predict drinking behaviours. Consistent with the PIER model of memory activation (Nelson et al., 1992), examination of patterns of response frequencies for the cue items indicated that set size effects may impact on the prediction of drinking by individual target words. For ambiguous cue words with alcohol use as part of their associative set, those with fewer related associates (smaller set size) had increased activation in memory and were more likely to elicit an alcohol-related response than those with a larger number of associates. Thus, set size may be a salient contributor to the effectiveness of target items in cue-association tasks and should be taken into account in any future refinement of these measurement paradigms.

3.4.2 Mediational analysis (Study 2).

Cross-sectional SEM modelling showed that frequency of drinking partially mediated the pathway between alcohol-related associative strength and heavy drinking. In line with an associative memory approach, implicit cognitions may be more predictive of the frequency of initiating drinking rather than the amount consumed. Cue-association tasks might tap associative memory representations in ways that are relatively free of introspection and summary judgements about outcomes (Stacy, 1997). As a result they may better assess cognitions that are influential in decisions to initiate drinking than other measures of explicit memory processes.

One explanation in support of this idea comes from Oei and Baldwin’s (1994) two-process theory of expectancy. This approach proposes that the relative role of implicit and explicit memory associations to explain drinking behaviour may vary
over time. According to Oei and Baldwin, early decisions to drink involve introspection and conscious processing of related cues and expected outcomes. With increased frequency of drinking, associations between related cues and outcomes become more automated and implicit in their influence on decisions to initiate drinking. To check this idea, I conducted supplementary analysis in the present study. Participants were categorised as low frequency (N = 66) or high frequency (N = 148) drinkers based on a median split (< or > 3 occasions/month) of frequency of drinking scores. An independent t-test showed that low frequency drinkers made significantly fewer alcohol-related responses on the memory association task (M = 1.09, SD = .83) compared to high frequency drinkers (M = 1.68, SD = .96), t (212) = 4.85, p < .0001.

Further to the suggestion that accessibility may be more important in determining frequency of drinking than how much one consumes on each occasion, expectancy research indicates that explicit memory processes may be more important in the prediction of quantity of drinking. For example, cross-sectional research using expectancy questionnaires has established a reliable association between endorsement of positive expectancies and quantity rather than frequency of drinking (Chen, Grube, & Madden, 1994; Lee, Greeley, & Oei, 1999; McMahon, Jones, & O’Donnell 1994; Mooney et al., 1987). Similarly, findings from longitudinal studies show that positive expectancies held for higher doses of alcohol were predictive of heavy drinking, and not frequency of drinking, among adolescents and young adults (Wiers et al., 1997). Therefore, the reasons why people continue to drink (i.e., heavy consumption) on any one occasion may reflect expectations of positive outcomes, with accessibility playing a lesser role once drinking has been initiated. This does not mean that implicit memory processes are unrelated to continued drinking. However, accessibility (as measured by cue-association tasks) may be less relevant to decision
making once drinking has begun and expectations of the positive outcomes of continued consumption may be better predictors of heavy drinking.

Further studies are needed to investigate the differential roles of implicit and explicit memory processes in predicting quantity/frequency dimensions of drinking behaviour. One difficulty with longitudinal research into these relationships is designing studies that overcome problems with protecting the integrity of later implicit tasks after completion of explicit measures. It would also be of interest to investigate the influence of alcohol consumption on responses to cue-association tasks. This may inform about the effects of actual consumption on alcohol-related memory activation and the role of such activation in drinking beyond nondrinking contexts. However, to ensure that the free association tasks were not contaminated by explicit retrieval processes, such studies would need to disguise both the consumption of alcohol and the nature of the memory measures.

3.4.3 Limitations

A limitation to Study 1 was that the cue-association measure was limited to written homograph cues. Other non-verbal ambiguous cues (e.g., pictures, symbols, smells) were not investigated and these may also tap memory associations that predict drinking. Only 10 ambiguous word cues were included in the selection process. While these 10 words were chosen based on normative responses to represent a range of levels of ambiguity in relation to drinking, they were not an exhaustive list. One consideration was that increasing the number of ambiguous cues beyond 10 might have led to a priming effect on subsequent responses. This would have had serious implications for the validity of the association tasks as measures of implicit memory. Nevertheless, other ambiguous homographs (e.g., cork, grape, tap) not used in the
present study could also elicit responses associated with alcohol use and further research is required to assess differential associations for these items.

The sample size was relatively small and correlations between individual cue words on alcohol-related responses were either small or nonexistent. This precluded the use of factor analytic methods that may have been more appropriate for the selection of cue words. Other limitations include reliance on self-reported alcohol use as the key dependent variable. Despite these shortcomings, convergent analysis support the findings and provide a starting point for refining and improving the utility of cue-association tasks as predictors of concurrent drinking behaviours.

Although the model analysis in Study 2 suggests that frequency of drinking partially mediates the effects of alcohol-related implicit cognition on heavy drinking, cross-sectional data does not allow for conclusions regarding direction of effects or causality. While further research is needed, mediational analysis provides preliminary evidence that implicit memory processes may have differential effects on quantity and frequency dimensions of drinking behaviours.
CHAPTER FOUR

Chronic accessibility of alcohol-related memory associations:

Memory network activation in the longitudinal prediction of undergraduate drinking
4.1 Introduction

According to implicit cognition approaches to models of alcohol use, accessibility of associations in memory between alcohol-related cues and alcohol use may be motivationally relevant (see Section 2.3.6). Although ambiguous alcohol-related cues may activate alcohol concepts in memory that predict drinking cross-sectionally (e.g., Stacy, 1995; see Section 2.3.6), limited evidence of longitudinal relationships among these variables has been presented. Prospective studies are important in establishing likely causal relationships among variables and controlling for the effects of autocorrelations in dependent measures (see Section 1.6).

Stacy (1997) used structural equation modelling to examine prospective relationships between free associations to ambiguous alcohol-related cues and drinking among undergraduates (see Section 2.3.6). Stacy’s model contained previous alcohol use, ambiguous alcohol-related cue associations, explicit outcome expectancies, impulsive sensation seeking, and control variables including age and gender. Results indicated that accessibility of alcohol-related memory predicted later drinking after controlling for previous drinking. Explicit outcome expectancy measures predicted subsequent alcohol use independently.

There were two limitations of this research study. The first was that the model did not incorporate the autoregression of memory accessibility (cue-association measures were administered at Time 1 only). A stronger test of the potential role of memory accessibility in predicting longitudinal changes in drinking is to measure both alcohol consumption and accessibility at each time point. This would make possible the evaluation of cross-lagged models of the potential impact of memory accessibility on drinking independent of autocorrelational effects on memory measures. Second, the time between assessments was short (one month) and this may
have unduly limited variability in alcohol consumption. Previous studies have found that a window of several months is necessary to capture sufficient variability in alcohol use amongst Australian university students (e.g., Kelly & Witkiewitz, 2003).

The primary aim of the present study was to address the limitations above by assessing the effect of accessibility of alcohol-related memory on alcohol use at three time points over a twelve-month period. It was hypothesised that Time 1 memory accessibility would predict Time 2 alcohol use and that Time 2 memory accessibility would predict Time 3 alcohol use after accounting for previous drinking, sensation seeking (see Section 3.1), and background measures of age and gender. Cross-lagged associations between memory accessibility and drinking were also investigated. It was expected that Time 1 alcohol use would predict Time 2 memory accessibility and that Time 2 alcohol use would predict Time 3 memory accessibility after controlling for the possible confounding effects of autocorrelations between memory accessibility measures at all assessment points.

A secondary aim of the study was to assess any differential contribution of memory accessibility and explicit expectancy measures to drinking (see Sections 1.4.2 and 1.5). Previous studies have found dissociations between responses to expectancy questionnaires and free associations to ambiguous cues in the prediction of alcohol use (e.g., Palfai & Wood, 2001; Stacy, 1997). The literature focuses on two major hypotheses in explanation of these findings. One view is that outcome expectancies are essentially epiphenomenal correlates of memory network activation. It is argued that while explicit belief measures may access long-term memory networks to some extent, they are limited or imperfect measures of more unconscious and automatic cognitive processes (Tiffany, 1990; Stacy, 1997). Tiffany proposes that repeated experience with alcohol use may result in progressively more automatised and
unconscious conditioning processes (see Section 2.2.1), and these processes eventually become stronger predictors of drinking than consideration of beliefs about possible outcomes (Tiffany, 1990). In this case it would be expected that both measures be at least modestly correlated together, given that they are held to assess some overlap in memory processes, but that memory accessibility would predict drinking over and above expectancies.

A second view is that these measures might tap independent aspects of cognition (e.g., Greenwald & Banaji, 1995; Wiers et al., 2002). According to this view, memory processes consist of an explicit component that represents cognitions responsive tointrospection and deliberation (e.g., expectancy self-reports), and an implicit component that represents spontaneous activation (accessibility) of alcohol-related memory networks dependent on cues and circumstances (see Sections 1.8.3 and 2.2.2). Evidence supports cue-association tasks as measures that access implicit memory processes rather than explicit memory processes (Roediger, 1990). For example, strong associates of words that are not presented during study trials may be potent cues in tests of cued recall (Nelson, McEvoy, & Dennis, 2000). If expectancies and accessibility do assess separate memory processes, it would be expected that little relationship exists between these measures, but that drinking would be would independently predicted by each. To investigate any differential effects of explicit and implicit measures of alcohol-related memory constructs in the present study, outcome expectancies were included in the prediction model. It was hypothesised that both measures would predict drinking, and that memory accessibility would have unique predictive value after controlling for explicit expectancies.

4.2 Method

4.2.1 Participants
A total of 214 first year university undergraduates participated at Time 1 as part of a course requirement (see Section 3.3.1). However, 52 of Time 1 participants identified themselves as international students. International students may attend Australian universities for short periods and their inclusion may have led to unnecessary attrition across the 12-month time frame of the study. Consequently, they were dropped from the present longitudinal sample. This left 162 participants at Time 1. There were 54 males and 108 females with a mean age of 20.2 years (SD = 4.7). Figure 4.1 shows a flow chart of participant attrition over the course of the study.

Of the 162 at Time 1, 45 participants (28%) did not attend at six-month follow-up. A further 39 participants (24%) did not attend at Time 3. The reasons given or apparent for non-attendance were: (i) left or deferred university (14% of non-attendees); (ii) contact details changed or were incorrect (non-contactable) (12%); and (iii) refusal to participate at follow-ups (3%). Seventy-one percent of non-attendees at Time 2 and 3 were scheduled for assessment but did not attend (students were offered AUD $10.00 to attend Time 2 and Time 3 follow-up and this remuneration was considered too small by a meaningful proportion of these). This resulted in a sample of 117 (33 male, 84 female) participants for use in prospective models at Time 2 and 78 (20 male, 58 female) participants at Time 3.
4.2.2 Measures

Alcohol-related memory associations were assessed using the cue-association task developed in Study 1 (see Section 3.2). Sensation seeking was assessed using the Impulsive Sensation Seeking subscale of the Zuckerman-Kuhlman Personality Questionnaire (ISS; Zuckerman et al., 1991; see Section 3.3.2).

To measure drinking at three waves of data while disguising the alcohol focus of the research (see Section 3.3.2), the Activities Checklist was used (see Section 3.3.2; Appendix B). Two indicators of alcohol use, Heavy Episodic Drinking (HED) and Average Alcohol Consumption (AAC) were derived from the Activities Checklist to capture relevant variability in undergraduate drinking. Heavy episodic drinking is a common pattern of consumption among undergraduates that is associated with harmful outcomes (O’Malley & Johnston, 2002; see Section 1.2) therefore separation from measures of average use is justified (Palfai & Wood, 2001).

Once final memory accessibility tasks were completed, Time 3 assessments were no longer subject to the need to disguise the alcohol-related nature of the study. Consequently, explicit measures of drinking and alcohol expectancies were included at Time 3 in addition to the Activities Checklist. To measure frequency of drinking over the past month, participants were asked to tick one of seven boxes for each day of the week that they usually have a drink. This approach accounts for weekend drinking that is characteristic of undergraduate consumption patterns (Weingardt et al., 1998). Average quantity was measured by placing a number in the box for each day of the week that was ticked above, showing how many drinks participants usually have on that day (see Appendix C). The derived explicit measure of alcohol consumption was the product of the quantity and frequency indicators. A composite
measure of average drinking was used because this was thought to best capture usual
drinking patterns in comparison to heavy episodic use among undergraduates.

Explicit alcohol outcome expectancies were assessed using the Drinking
Expectancy Questionnaire (DEQ; Young & Knight, 1989; see Section 1.4.2). The
DEQ consists of three positive expectancy domains (social assertion, sexual
enhancement, tension reduction), two negative domains (cognitive impairment and
dependence), and an affect change domain containing both positive and negative
items. Total DEQ score may also be used as an overall measure of expectancies. The
DEQ was developed using Australian and New Zealand populations and has
demonstrated predictive validity over time. For example, test-retest reliabilities of .61
to .88 have been reported for DEQ domains over a one-month period in a sample of
185 undergraduates (Young & Oei, 1996).

Finally, an important issue was whether the scientific integrity of the implicit
task was preserved over the course of the study. To check this, participants completed
the following validity check question after completing Time 3 memory measures:
“Please write below what you think the main emphasis and goals of the study were. In
other words, tell us what you think the study was about” (see Appendix D). Any
participants whose responses made reference to alcohol use (e.g., drinking) were
removed from the analysis.

4.2.3 Procedure

Participants were informed that they were completing an anonymous survey
described as an investigation of thoughts and attitudes about health-related issues
affecting undergraduates. No mention of the alcohol-related focus of the study was
made. Participants completed informed consent outlining the confidential and
voluntary nature of the study and that participants would be requested to attend at two
further assessments over the next twelve months. Once consent was given, Time 1
surveys were administered individually in a quiet, air-conditioned room during
March, 2003. Time 2 assessments took place six months after Time 1 over a two-
week period in August, 2003, while Time 3 measures were taken in April of 2004. To
facilitate participation at follow-ups, participants were contacted individually by
members of the research team and an appointment made for them to attend the Time 2
and Time 3 assessments. Initial contact was made by telephone. If students were
unable to make an appointment at that time, messages were left regarding a contact
number participant’s could call or permission to e-mail appointment times was
sought. Those who failed to attend appointments for Round 1 assessments were
followed up with a second telephone call and a new appointment time was made for
Round 2 assessments. This process was repeated for the third and final round of
assessments. Instructional set and coding procedures for all assessment times were
identical to Study 1 (see Section 3.2.1.2.2).

4.3 Results

Before conducting analysis, Time 1 and Time 2 AAC and the age variable
were subjected to logarithmic transformations, while a square root transformation was
applied to Time 3 AAC to reduce skewness (Hoaglin, Mosteller, & Tukey, 1983;
Tabachnick & Fidell, 1999). At Time 1, most participants (88.3%) indicated that they
had drunk alcohol at least once in the last month. On average, participants drank on
4.93 occasions per month with large variations in this pattern (SD = 4.5: Range = 0 to
16 occasions). A mean quantity of 5.1 (SD = 3.23) standard drinks (i.e., a pot of beer,
a glass of wine, a nip of spirits) was consumed at each session. Regarding heavy
episodic drinking, 64% of participants drank greater than six drinks on at least one
occasion over the last month and 31.1% indicated drinking more than six drinks on
every drinking occasion. The intraclass correlation between the Activities Checklist
AAC and the explicit alcohol use measure at Time 3 was high (.84), $F(1,77) = 6.09,
p < .0001$, indicating that the Activities Checklist was comparable to an explicit self-
report measure of alcohol consumption.

For the cue-association task at Time 1, 144 participants (87.8%) recorded at
least one alcohol-related response. Twenty participants (12% of the sample) did not
make an alcohol-related response. Seventy-three (43.7%) made one response, 41
(24.6%) made two responses, 25 (15%) made three responses, and 5 (3%) made four
responses. Overall, the mean number of alcohol-related responses was 1.52 (SD =
0.96) from a possible range of 0 to 5. No significant differences in the number of
alcohol-related responses were found for the four permutated forms, $F(3, 159) = 1.45,
p > .05$.

To check whether the pattern of participant attrition systematically affected
study variables over time, a three-way repeated measures ANOVA assessed any
differences between Time 1, Time 2 and Time 3 completers. Results showed no
significant differences between these groups across time on any of the key variables
of memory associations, alcohol use measures, age, gender, and sensation seeking.
Responses to the validity check question showed that two participants indicated
awareness that alcohol use might be a focus of the research and these were dropped
from further analysis.

4.3.1 Overview of statistical method

A series of hierarchical multiple regression analyses were conducted to assess
the role of alcohol-related accessibility in prospectively predicting alcohol
consumption measures. To assess the utility of memory accessibility at Time 1 and
Time 2 to predict Time 2 and Time 3 drinking respectively, Time 2 alcohol use
measures (AAC and HED) were each regressed on Time 1 age, gender, sensation seeking, and memory accessibility after first controlling for Time 1 alcohol use. Following this, Time 3 alcohol use was regressed on Time 2 age, gender, sensation seeking, explicit expectancies (DEQ scores) and memory associations after controlling for Time 2 alcohol use. Hierarchical regression was chosen over more sophisticated methods (e.g., Structural Equations Modelling; SEM) because SEM analysis may show unreliable or inflated path values in samples having fewer than 150 participants (Cole & Maxwell, 2003).

Table 4.1 shows correlations between variables in the above models. Memory accessibility, sensation seeking and expectancies showed moderate and significant correlations with alcohol use measures at all time points (pearsons $r$ ranged from .285 to .494). There was little or no relationship between age and drinking or gender and drinking. Memory accessibility measures and expectancies were not correlated. A-priori power analysis showed that to obtain a power of .80 where $\alpha = .05$, a sample of $N = 73$ was required to detect a correlation of .33 in the population (Howell, 1997). Results of previous studies of memory accessibility and alcohol use indicate a correlation coefficient of approximately .33 between accessibility and drinking (e.g., Stacy, 1995; 1997; see Section 3.3.4). In the present study, results indicated a correlation of approximately .35 between accessibility and alcohol use measures. Thus, an acceptable power of .85 was obtained at Time 3 with $N = 78$.

4.3.1.1 Time 2 analysis

Results of hierarchical regression models at Time 2 are presented in Table 4.2. The two models respectively accounted for 60% and 57% of the variance in average consumption, $F (5, 111) = 33.61$, $p < .001$, and heavy episodic drinking, $F (5, 111) = 29.26$, $p < .001$. As expected, Time 1 alcohol use significantly predicted Time 2
alcohol use in both models. Neither the combination of gender and age at Step 2 nor sensation seeking at Step 3 were significant predictors of the two alcohol use measures at Time 2. On the final step, Time 1 accessibility significantly predicted Time 2 average consumption ($\beta = .21, p < .01$) and heavy episodic drinking ($\beta = .14, p < .05$).

Supplementary hierarchical regression analysis was also conducted on a combined indicator of drinking comprising the product of AAC and HED measures. As expected, this model was significant and explained 60% of variance in consumption, $F(5, 111) = 38.62, p < .001$. However, after controlling for Time 1 drinking, no other variables in the model were unique predictors of the combined consumption measure.
### Table 4.1

**Correlations between Model Variables at Three Time Points**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
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<tr>
<td>1. Memory accessibility Time 1</td>
<td>-</td>
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<td>2. Memory accessibility Time 2</td>
<td>.591**</td>
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<td>3. Memory accessibility Time 3</td>
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<td>.234*</td>
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<td>4. AAC Time 1</td>
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<td>.293*</td>
<td>.445**</td>
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<td>5. AAC Time 2</td>
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<td>.293*</td>
<td>.378**</td>
<td>.823**</td>
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<td>6. AAC Time 3</td>
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<td>.418**</td>
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<td>7. HED Time 1</td>
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<td>.305**</td>
<td>.426**</td>
<td>.777**</td>
<td>.770**</td>
<td>.647**</td>
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<td>8. HED Time 2</td>
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<td>.361**</td>
<td>.334**</td>
<td>.709**</td>
<td>.772**</td>
<td>.714**</td>
<td>.845**</td>
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<td>9. HED Time 3</td>
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<td>.406**</td>
<td>.623**</td>
<td>.622**</td>
<td>.892**</td>
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<td>.673**</td>
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<td>10. Sensation seeking</td>
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<td>.147</td>
<td>.141</td>
<td>.448**</td>
<td>.285**</td>
<td>.412**</td>
<td>.397**</td>
<td>.440**</td>
<td>.302**</td>
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<td>11. Expectancies Time 3</td>
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<td>.085</td>
<td>.165</td>
<td>.411**</td>
<td>.384**</td>
<td>.364**</td>
<td>.494**</td>
<td>.464**</td>
<td>.395**</td>
<td>.291**</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>12. Gender</td>
<td>.157</td>
<td>.001</td>
<td>.233</td>
<td>.192</td>
<td>.241*</td>
<td>.013</td>
<td>.057</td>
<td>.016</td>
<td>.043</td>
<td>.064</td>
<td>.075</td>
<td>-</td>
</tr>
</tbody>
</table>

*Note.* *p < .05 (1-tailed). **p < .01 (1-tailed). AAC = Average Alcohol Consumption. HED = Heavy Episodic Drinking.

The Age variable was not significantly correlated with any variables and was omitted.
### Table 4.2

**Hierarchical Regressions of Time 1 Alcohol Use Measures, Gender, Age, Sensation Seeking and Memory Accessibility on Time 2 Alcohol Use Measures (N = 117).**

<table>
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<tr>
<th>Variables</th>
<th>R²</th>
<th>R² Change</th>
<th>F Change Value</th>
<th>dfs</th>
<th>Beta</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time 2 AAC</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 1. Time 1 AAC</td>
<td>.56</td>
<td>.56</td>
<td>145.58***</td>
<td>115</td>
<td>.75***</td>
</tr>
<tr>
<td>Step 2. Gender + Age</td>
<td>.57</td>
<td>.01</td>
<td>.85</td>
<td>113</td>
<td>.06</td>
</tr>
<tr>
<td>Step 3. Sensation Seeking</td>
<td>.57</td>
<td>.00</td>
<td>.01</td>
<td>112</td>
<td>.01</td>
</tr>
<tr>
<td>Step 4. Time 1 Memory Access.</td>
<td>.60</td>
<td>.04</td>
<td>10.33**</td>
<td>111</td>
<td>.21**</td>
</tr>
<tr>
<td><strong>Time 2 HED</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Step 1. Time 1 HED</td>
<td>.54</td>
<td>.54</td>
<td>136.00***</td>
<td>115</td>
<td>.73***</td>
</tr>
<tr>
<td>Step 2. Gender + Age</td>
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<td>.00</td>
<td>.58</td>
<td>113</td>
<td>.06</td>
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<tr>
<td>Step 3. Sensation Seeking</td>
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<td>.01</td>
<td>1.16</td>
<td>112</td>
<td>.07</td>
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<tr>
<td>Step 4. Time 1 Memory Access.</td>
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<td>4.50*</td>
<td>111</td>
<td>.14*</td>
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</tbody>
</table>

**Notes.** Beta values are standardised regression coefficients taken from each step in the model. AAC = Average Alcohol Consumption. HED = Heavy Episodic Drinking.

* p < .05. ** p < .01. *** p < .001.
4.3.1.2 Time 3 analysis

Results for Time 3 models are presented in Table 4.3. Model 1 accounted for 56% of the variance in average consumption, $F(6, 71) = 13.71, p < .001$, while Model 2 accounted for 56% of the variance in heavy episodic drinking, $F(6, 71) = 13.73, p < .001$. Time 2 drinking predicted Time 3 drinking in both models, $\beta = .65$ and $.67, p < .001$, for average consumption and heavy drinking respectively. In contrast to Time 2 models, gender and age at Step 2 were significant predictors of AAC at Time 3, while age predicted HED at Time 3. Negative beta values in Model 1 indicate that AAC fell with age and that female students drank less than male students did. Negative values in Model 2 show that older students reported less incidence of HED but that HED was not different across gender. Sensation seeking at Step 3 predicted AAC but not HED. In contrast to expectations, after controlling for previous drinking, explicit expectancies (total DEQ score) at Step 4 were not significant predictors in either model. Investigation of separate DEQ domains was not undertaken in the hierarchical analysis because, with the addition of six DEQ domains, the ratio of cases ($N = 78$) to independent variables (11) would have rendered the prediction model meaningless (Green 1991). Finally, accessibility of alcohol-related associations at Time 2 significantly predicted Time 3 average consumption ($\beta = .22, p < .01$) and heavy episodic drinking ($\beta = .23, p < .01$).

4.3.2 Cross-lagged prospective models

A further series of hierarchical regression models were tested to investigate cross-lagged prospective relationships between alcohol use and memory accessibility. A stringent test of these associations would control for any autocorrelational effects between Time 1 and Time 2, and Time 2 and Time 3 cue-association tasks. To do this, analysis tested whether Time 1 alcohol use measures would predict Time 2 memory
accessibility after controlling for the effects of Time 1 memory associations. Identical analysis was conducted at Time 3 substituting Time 2 variables.

Table 4.3

Hierarchical Regressions of Time 2 Alcohol Use Measures, Gender, Age, Sensation Seeking, Expectancies, and Memory Accessibility on Time 3 Alcohol Use Measures (N = 78).

<table>
<thead>
<tr>
<th>Variables</th>
<th>R²</th>
<th>R² Change</th>
<th>F Change Value</th>
<th>dfs</th>
<th>Beta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time 3 AAC</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Step 1. Time 2 AAC</td>
<td>.42</td>
<td>.42</td>
<td>50.53***</td>
<td>76</td>
<td>.65***</td>
</tr>
<tr>
<td>Step 2. Gender + Age</td>
<td>.47</td>
<td>.05</td>
<td>3.49*</td>
<td>74</td>
<td>-.19*</td>
</tr>
<tr>
<td>Step 3. Sensation Seeking</td>
<td>.51</td>
<td>.04</td>
<td>5.35*</td>
<td>73</td>
<td>.21*</td>
</tr>
<tr>
<td>Step 4. Expectancies</td>
<td>.51</td>
<td>.00</td>
<td>.33</td>
<td>72</td>
<td>.05</td>
</tr>
<tr>
<td>Step 5. Time 2 Memory Access.</td>
<td>.55</td>
<td>.04</td>
<td>6.58*</td>
<td>71</td>
<td>.22*</td>
</tr>
<tr>
<td>Time 3 HED</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 1. Time 2 HED</td>
<td>.45</td>
<td>.45</td>
<td>58.65***</td>
<td>76</td>
<td>.67***</td>
</tr>
<tr>
<td>Step 2. Gender + Age</td>
<td>.50</td>
<td>.05</td>
<td>3.44*</td>
<td>74</td>
<td>-.22*</td>
</tr>
<tr>
<td>Step 3. Sensation Seeking</td>
<td>.50</td>
<td>.00</td>
<td>.16</td>
<td>73</td>
<td>.04</td>
</tr>
<tr>
<td>Step 4. Expectancies</td>
<td>.51</td>
<td>.01</td>
<td>.69</td>
<td>72</td>
<td>.08</td>
</tr>
<tr>
<td>Step 5. Time 2 Memory Access.</td>
<td>.56</td>
<td>.05</td>
<td>6.98**</td>
<td>71</td>
<td>.23**</td>
</tr>
</tbody>
</table>

Notes. Beta values are standardised regression coefficients taken from each step in the model. AAC = Average Alcohol Consumption. HED = Heavy Episodic Drinking.

* p < .05. ** p < .01. *** p < .001.
4.3.2.1 Time 2 analysis

Model 1 (average consumption as predictor) accounted for 28% of the variance in Time 2 memory accessibility, $F(2, 114) = 22.40$, $p < .001$, while Model 2 (heavy drinking as predictor) accounted for 30%, $F(2, 114) = 24.62$, $p < .001$. Time 1 memory accessibility significantly predicted Time 2 memory accessibility in both models ($\beta = .51$, $p < .001$) for both average consumption and heavy drinking. After controlling for autocorrelation in memory accessibility, Time 1 heavy drinking significantly predicted Time 2 memory accessibility ($\beta = .21$, $p < .01$). While Time 1 average consumption did not reach significance in predicting Time 2 memory accessibility, results showed a trend in the expected direction ($\beta = .16$, $p < .06$).

4.3.2.2 Time 3 analysis

In this analysis, 16% of the variance in Time 3 memory accessibility was accounted for by Model 1, $F(2, 76) = 6.65$, $p < .05$, while Model 2 accounted for 13%, $F(2, 76) = 5.10$, $p < .01$. In both models, Time 2 memory accessibility significantly predicted Time 3 memory accessibility ($\beta = .23$, $p < .05$) for both average consumption and heavy drinking. After accounting for Time 2 memory accessibility, Time 2 average consumption and heavy drinking both significantly predicted Time 3 memory accessibility, ($\beta = .34$, $p < .01$) and ($\beta = .29$, $p < .05$) respectively. A diagrammatic representation of integrated findings across all prospective models is presented in Figures 4.2 and 4.3. Because analysis required two regressions to assess cross-lagged associations between drinking and memory accessibility at Time 2 and Time 3, a Bonferroni correction of significant alpha (.05/4 = .0125) was introduced to control for family wise error (Johnson & Mott, 2000).
Figure 4.2. Diagram of standardised solution for cross-lagged longitudinal associations between accessibility and average drinking. At Time 2, $N = 117$, at Time 3, $N = 78$. Dotted lines indicate a non-significant relationship. Note: Bonferroni * $p < .0125$. ** $p < .01$. *** $p < .001$.

Figure 4.3. Diagram of standardised solution for longitudinal cross-lagged associations between accessibility and heavy episodic drinking. At Time 2, $N = 117$, at Time 3, $N = 78$. Note: Bonferroni * $p < .0125$. ** $p < .01$. *** $p < .001$. 
4.4 Discussion

The overall aim of the present study was to examine the prospective relationships between accessibility of alcohol-related memory and drinking behaviours. The longitudinal effects of accessibility on alcohol use were examined after controlling for previous alcohol use and potentially confounding autocorrelations between memory associations. Results supported the hypotheses that Time 1 memory accessibility would predict Time 2 average consumption, and that Time 2 accessibility would predict Time 3 average consumption after accounting for the effects of alcohol use at Time 1 and Time 2. Similar support was found for relationships between accessibility and heavy episodic drinking with the exception that accessibility at Time 1 was not a significant predictor of heavy drinking at Time 2 following introduction of a more conservative alpha. Significant cross-lagged associations were also found between Time 1 heavy drinking and Time 2 memory accessibility, and between Time 2 average consumption and Time 3 memory accessibility, above and beyond any autocorrelational effects between Time 1 and Time 2 and between Time 2 and Time 3 memory measures. Although Time 1 average consumption and Time 2 heavy drinking were not significant predictors of Time 2 and Time 3 memory accessibility after Bonferroni correction, results showed a trend in the expected direction.

A key finding of this study was the occurrence of significant cross-lagged associations independent of autocorrelational effects in accessibility of alcohol-related memory associations. As expected, the relationship between Time 1 and Time 2 alcohol consumption indices was strong (.75 for average consumption and .73 for heavy drinking). Similar relationships existed between Time 2 and Time 3 drinking measures (.65 for both indicators). A moderate to high association (.51) between Time 1 and Time 2 cue-association measures was also found. This
relationship remained a trend between Time 2 and Time 3 implicit tasks but was no longer significant following Bonferroni correction. That significant cross-lag effects were found over and above the autocorrelation of memory measures and drinking attests to the potential importance of memory accessibility. It is difficult to establish these effects given the typically high autocorrelations found for alcohol use (e.g., Kelly & Witkiewitz, 2003; Stacy, 1997).

The study also accounted for the possibility that repetition of the cue-association task may have had a practice or priming effect on task responses. For example, given that target items in the memory task were identical at Time 1, 2, and 3, participants may have remembered and recorded, in addition to any new associations made, alcohol-related responses from previous time points. These remembered responses could possibly provide further associative cues, making a high correlation and mean score likely. However, repeated measures $t$-tests indicated there was no evidence of increases in the number of alcohol-related responses across time. A further strength of the study was that the validity check question demonstrated the methodology employed was successful in ensuring the cue-association tasks remained implicit in their administration.

4.4.1 Effect sizes for cross-lag models

Effect sizes (expressed as $R^2$ change) for pathways between Time 1 memory accessibility and Time 2 drinking were .04 for average consumption and .02 for heavy drinking. For cross-lag pathways between Time 1 drinking and Time 2 accessibility, $R^2$ change figures were .02 for average consumption and .04 for heavy drinking. At Time 3, the pathway between Time 2 memory accessibility and Time 3 average alcohol consumption was $R^2$ change = .04, and between accessibility and heavy drinking, $R^2$ change = .05. $R^2$ change for cross-lagged pathways between Time 2
average consumption and heavy drinking and Time 3 memory accessibility were .10 and .07 respectively.

According to Cohen’s (1992) categories of effect size, these effect sizes are small (based on power of .80 for each model; N = 117 at Time 2 and N = 78 at Time 3). In related research where R² change figures (or other measures of effect size) have not been reported, standardised beta weights for predictive pathways offer an approximation of effect size (Fidler, Thomason, Cumming, Finch, & Leeman, 2004). In the present study, significant beta weights for cross-lagged effects ranged from .14 to .34. These findings are consistent with Stacy (1997) who reported a standardised beta weight of .33 between accessibility and later drinking after controlling for previous drinking in undergraduates.

4.4.2 Explicit and implicit measures

A second goal of the present study was to assess the relative contribution of memory accessibility and explicit expectancies to drinking. Results did not support the hypothesis that explicit expectancies would independently predict drinking after controlling for earlier use. This is inconsistent with Stacy (1997) who found modest (β = .09) but significant associations between expectancies and drinking in undergraduates after accounting for earlier consumption. However, in the present study expectancies comprised the total DEQ score and this composite measure might have obscured possible significant findings at the level of specific expectancy domains (see Leigh, 1989; Leigh & Stacy, 1991; Section 1.7.2). To investigate this possibility, a supplementary regression analysis was conducted where Time 3 alcohol use (AAC and HED) was regressed on expectancy domains of the DEQ. Results of supplementary analysis showed that the value of the multiple correlation for both AAC and HED models was significantly different from zero, F (6, 71) = 7.18, p <
.001 and $F(6, 71) = 8.77, p < .001$ respectively. However, DEQ domains of Dependence and Affective Change were the only significant predictors of alcohol use (see Table 4.4). Thus, expectancies may have been shown to be independent predictors of drinking had the sample size been large enough at Time 3 to include separate DEQ domains in the prospective models.

Despite the finding that expectancies did not predict drinking measures, there is some evidence that memory accessibility and explicit expectancies may assess different aspects of alcohol-related memory processes. Examination of correlations revealed little or no relationship between expectancies and memory accessibility (Pearson’s $r$ ranged from .08 to .16), although both measures were significantly correlated with drinking (see Table 4.1). Correlations between these two measures of alcohol-related memory might be likely if expectancies were merely an imprecise measure of accessibility (Tiffany, 1990). Rather, the non-association between these tasks indicates that implicit and explicit measures may reflect independent memory constructs (Greenwald & Banaji, 1995; see Section 4.1). Human memory research has provided evidence for conceptualising these aspects as two memory systems. For example, among people with memory deficits, implicit and explicit tests of memory have shown differential responses (Shimamura & Squire, 1994). Because explicit tasks may allow for summary judgement activities while cue-association measures are unavailable to introspection and influence responses implicitly (see Section 2.3.6), present findings are consistent with the possibility that implicit and explicit measures may assess separate memory processes that influence drinking behaviours differently.
Table 4.4

*Standard Multiple Regression of DEQ Domains on Time 3 Alcohol Use (N = 78).*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>β</th>
<th>R</th>
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<td>Assertion</td>
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<td>.40</td>
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<td>6.39</td>
<td>.41**</td>
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<tr>
<td>Sexual Enhancement</td>
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<td>4.37</td>
<td>.19</td>
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<td>Cognitive Change</td>
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<td>2.62</td>
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<tr>
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<td>.44</td>
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<tr>
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<tr>
<td>Tension Reduction</td>
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<td></td>
<td>.08</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

*Notes.* *p < .05.* **p < .01.* ***p < .001.*
4.4.3 Limitations

There was attrition over the course of the research that may have limited variability in key indicators. However, missing data did not appear to systematically affect study variables. Results of repeated measures ANOVA analysis presented earlier showed no differences between completers across time (see Section 4.3). Additionally, missing values analysis using separate variance t-tests revealed no significant differences between pairs of present and missing data on indicator variables.

The sample was predominantly female ($M = 70\%$) at the three time points. However, only the prospective model at Time 3 showed significant effects for gender on AAC, indicating that females drank less than males did (see Section 4.3.1.2). There were no effects of gender on HED in this model or for HED and AAC in any other models. Between groups t-tests revealed no significant differences between males and females on means of alcohol use measures at all three data points. This is consistent with recent epidemiological studies suggesting that young Australian males and females are drinking at similar levels (Jonas et al., 2000; see Section 3.1).

Finally, responses to the cue-association task showed a limited range (0 to 3). However, this is consistent with previous studies that found free associations to four ambiguous alcohol-related word cues were a well-supported memory association correlate of alcohol use (e.g., Stacy, 1995). At any rate, the issue with restricted range is not one of exaggeration but rather of underestimation (Howell, 1997) and the cue-association measure may have provided a conservative estimate of the relationship between memory accessibility and alcohol use.

4.4.4 Conclusions
Despite the limitations above, cross-lagged results support the utility of accessibility of alcohol-related memory in the longitudinal prediction of undergraduate drinking behaviours. These findings remained after controlling for previous use and any autocorrelational effects between memory measures. This study evaluated chronic accessibility of alcohol-related associations. Further research is needed to investigate individual variability in memory associations and its effect on drinking behaviour. It would be of interest to investigate how contextual factors might influence accessibility for implicit alcohol-related memories and the next chapter will describe an experimental study designed to explore this idea. Investigating the relationships between chronic and contextual accessibility could go some of the way to building models of enduring and within-subject vulnerability to problematic drinking.
CHAPTER FIVE

Contextual accessibility of alcohol-related memory associations: The effects of an implicit mood prime
5.1 Introduction

5.1.1 Overview

In implicit cognition theory, accessibility of alcohol-related constructs in memory is conceptualised as a mediator of the relationship between related cues and decisions to drink (Stacy, 1995; see Section 2.3.6). While there is good evidence that chronic accessibility of alcohol-related memory associations predicts drinking cross-sectionally (Ames, Zogg, & Stacy, 2002; Palfai & Wood, 2001; Stacy, 1995; Weingardt et al., 1996) and prospectively (Kelly, Masterman & Marlatt, in press; Stacy, 1997; see Chapters 3 & 4), further research is needed to explore individual variability in memory accessibility.

5.1.2 Rationale for the study of contextual accessibility of alcohol-related memory networks

It can be argued that context is a salient contributor to individual differences in accessibility of alcohol-related memory. According to social learning theory, contextual factors are a primary source of substance-specific cognitions related to drug use behaviour (Bandura, 1984; see Section 1.7.1). Moreover, cognitive processing theories of addiction suggest that contextual features of drug use and its outcomes become automatically associated together with experience (Tiffany, 1990; see Section 2.2.2). There has been little research into the effects of specific contexts under which implicit alcohol-related memories are retrieved in explanations of the relationship between alcohol-related accessibility and drinking. This context-based source of variability in accessibility may interact with chronic accessibility to predict drinking.

5.1.2.1 Affective context and alcohol use
One contextual factor that may impact on drinking behaviour is affective state or mood. There is ample evidence for the significance of affective state in motivating the initiation and maintenance of alcohol consumption. Several studies show that negative mood states (e.g., depressed, tense, anxious mood) may motivate people to behave in ways (e.g., consume alcohol) that alleviates negative affect. For example, among recreational drinkers depressed mood has been found to increase craving and motivation to drink (Willner, Field, Pitts, & Reeve, 1998). Nervous mood has also predicted increased drinking later in the day in a community sample of social drinkers. This association was unrelated to family history of alcoholism, problem drinking, and measures of anxiety and depression (Swendsen, et al. 2000). Among males treated for alcohol addiction, negative affect (depressed or anxious mood) was the most frequently endorsed determinate of relapse to drinking (Strowig, 2000). These findings are consistent with a coping theory approach that negative affective states may act as motivators for coping responses (see Bandura, 1989; Carver & Scheier, 1990).

The relationship between positive mood and drinking has received somewhat less attention in the literature. However, drinking to enhance positive mood has been a commonly endorsed motive for drinking among university undergraduates (e.g., Stewart et al., 1996). Positive mood enhancement motives have also predicted alcohol-related problems in college students (Carey & Correia, 1997) and are a frequent motivator for drinking in social situations (Fromme & Dunn, 1992: Kilty, 1990). In addition, positive affect outcomes of drinking (i.e., expectancies of positive mood: see Section 1.3.1) have been extensively investigated and are strong predictors of expectancy research (see Sections 1.4 & 1.5).
5.1.2.2 Mood and memory

Self-report evidence outlined above suggests that negative and positive mood states may be important contextual factors that impact on drinking behaviour. From an associative memory-network perspective, memory and mood states may be linked via associative nodes (Bower, 1981; see Section 2.2.2). According to this view, events and affect are associated together in memory such that activation of memory representations congruent with affect will occur when current emotional state matches one previously encoded. In this way, affective state may prime related information in memory that could bias behavioural decision making implicitly (Forgas 1995; see Section 2.3.6). It has also been suggested that the potential mood-altering properties of various substances, including ethanol, can result in state-dependent effects (Bower, 1995). To illustrate, if an individual finds that current negative affect is alleviated by alcohol consumption, they will (in theory) develop interconnected associations in memory between negative mood and negative affect alleviation related to alcohol use. Consequently, when the individual encounters a context that arouses negative mood and primes alcohol-related cognitions, the retrieval of concepts associated with both drinking and negative mood will be enhanced. This is consistent with an assumption of associative memory models that recall is improved when retrieval conditions are similar to, and compatible with, encoding conditions (for a review see Tulving, 1983; Roediger & Shrinivas, 1993). According to the situational specificity hypothesis, similarities in processing operations between earlier encoding situations and later retrieval situations should facilitate retrieval. In other words, priming of mood state should enhance the retrieval of information encoded in a similar mood state (Bower, 1981; 1992).
In support, previous research has found that inducement of negative mood has facilitated retrieval of unpleasant memories compared to pleasant memories (Teasdale & Fogarty, 1979). An associative memory approach suggests that mood may be a key contextual factor influencing drinking through accessibility of alcohol-related memory associations. In this case, a positive mood state should facilitate memory associations that are related to positive affective experiences and drinking. Conversely, a negative mood should facilitate memory associations related to negative affective experiences and drinking.

5.1.3 Evidence for the role of context in alcohol-related accessibility

Overall, there has been limited research exploring the association between context specific implicit retrieval processes and accessibility for alcohol-related memory. There is evidence from one study that situational context may be important to accessibility of alcohol-related memory (Wiers et al., 2003). In this study, undergraduate drinkers (N = 50 for each condition) were approached for assessment in one of three contexts, neutral, pre-bar, and bar. The neutral context was a communal area used for casual study and socialising. The bar setting was a licensed on-campus pub, while the connecting walkway between the communal area and the pub comprised the pre-bar context. Participants responded to measures of drinking and an outcome-association task (see Section 2.3.5) across the three settings. The alcohol focus of the study was not revealed to participants and analysis only included those students who had not yet consumed alcohol on the day of testing. Participants reported greater accessibility of alcohol associations in the bar and pre-bar context compared to the neutral context. The authors suggest that physical cues (e.g., smell, alcohol-related paraphernalia) in combination with probable intentions and decisions
indicated by entering the bar, contribute to activation of related memory networks leading to a facilitation of alcohol associations.

One study that used an implicit response latency paradigm (see Section 2.3.2.1) found that negative affect (state anxiety) facilitated implicit priming for alcohol-related cue words in problem drinkers (Zack, Toneatto, & MacLeod, 1999). In a study among university undergraduates it was reported that negative mood phrases primed alcohol targets while positive mood phrases did not (Zack, Poulos, Fragopoulos, & MacLeod, 2003). Although these findings point to implicit associations between mood descriptive phrases and alcohol targets, actual changes in mood state were not examined and further research directly assessing manipulations of context is required.

5.1.4 Integration and hypotheses

There is some evidence to suggest that contextual factors may account for variability in the relationship between accessibility of alcohol-related memory and alcohol consumption (Wiers et al., 2003). While the effects of mood on alcohol-related memory accessibility has received little research attention, data suggesting established relationships between mood and motivations to drink indicate that mood may be a powerful implicit contextual antecedent that could interact with chronic accessibility of alcohol associations to influence drinking decisions. Given these proposed links, the present study used an implicit musical mood induction procedure to explore the effect of mood state on accessibility of alcohol-related memory associations in undergraduates. Because both positive and negative mood has been found to occasion drinking among students (e.g., Carey & Correia, 1997; Evans & Dunn, 1995), it was expected that positive and negative mood state would increase accessibility for alcohol-related associations compared to a neutral mood condition.
Associative memory theory posits that physical cues, related affect, and outcomes of drug use become automatically associated together with experience (Oei & Baldwin, 1994). Thus, a discrete implicit measure of one of these elements should provide a strong test of its association with the other elements. For example, words used as cues in cue-association tasks (e.g., can, port; see Section 3.2.3) are relatively free of affective content and cue-association measures may offer a stringent test of the effect of current mood on accessibility. In the present study, the impact of a context specific variable (current mood) on accessibility of alcohol-related associations was investigated. If mood state differentially affects alcohol-related memory accessibility as measured by a cue-association measure alone, this would offer further support for a parallel processing approach (e.g., Bower, 1995; Hintzman, 1986).

However, the effects of a mood manipulation on a single measure of accessibility (i.e., cue-association task) may not be strong across a relatively small sample where drinking experience is similar (although in larger samples it would be expected that such effects should be found). To increase the likelihood of measurable effects, predictions relate only to those participants who were current drinkers and who made positive or negative affect change in the appropriate mood manipulation. In this case, it was expected that; (a) alcohol use measures would predict memory accessibility; (b) mood condition alone would not be a significant predictor; and (c) there would be a significant interaction between alcohol use and mood in the prediction of accessibility. Specifically, those participants who showed increased positive or negative mood in the corresponding mood manipulation and who were heavier drinkers, would evidence effects of mood state on alcohol-related accessibility. No such effects should be found for students in the neutral mood condition.
5.2 Method

5.2.1 Participants

The sample consisted of 106 university undergraduates from an introductory psychology course who participated in return for research credit points. There were 74 females and 31 males with a mean age of 20.5 years (SD = 4.18). Five participants (4.8%) indicated that English was their second language. The majority of participants were current drinkers (96.2%) who indicated that they had drunk at least once over the past month. The remaining 3.8% identified themselves as current abstainers. Participants reported a mean frequency of drinking sessions of 6.1 per month (SD = 4.6) while mean quantity in number of standard drinks per session was 3.2 (SD = 2.8).

5.2.2 Measures

In line with previous mood induction research (Albersnagel, 1988; McKee et al., 2003) a visual analogue scale was used to assess current mood state. This type of scale allows for a more fine-grained capture of variability in mood than conventional likert-type scales. The scale consisted of eight adjectives assessing positive mood (e.g., cheerful, happy, pleased) and negative mood (e.g., sad, despondent, depressed, blue). To complete the scale, participants were required to place a vertical mark on a 100-mm horizontal line with endpoints anchored at 0 (not at all) to 100 (extremely) that indicated to what extent they felt this way at the present moment.

To prime mood state, a musical mood induction procedure was used. Musical mood induction has been found to be effective in changing mood in several studies (e.g., Goldstein, Wall, McKee & Hinson, 2003; Halberstadt, Neidenthal & Kushner, 1995; Hufford, 2001). Participants listened to a 10-minute segment of classical music to induce a negative mood (Prokofiev’s Russia Under the Mongolian Yoke and...
Sibelius’ Swan of Tuonela) or positive mood (Bach’s Brandenburg Concertos No.’s 2 and 3 and Handel’s Water Music). These selections have been found to successfully change mood in previous studies (e.g., Goodwin & Sher, 1993; Hufford, 2001). In the control/neutral condition, participants were given a 10-minute break while they remained in the laboratory. The neutral condition was identical to Hufford, (2001) and Goldstein et al. (2003) who found no changes in mood among control participants for their studies. This was also justified because any other organised activity may potentially alter mood while waiting in a casual setting for 10 minutes is typical of many such instances in daily undergraduate life and is unlikely to impact on mood.

Drinking was assessed using the Activities Checklist (see Section 3.3.2) and an explicit self-report measure of quantity and frequency of consumption (see Section 4.2.2). Memory accessibility was assessed using the cue-association task previously developed (see Section 3.2). To control for possible confounding effects of trait negative affect, the Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1964) was administered at baseline. The BDI is a valid and reliable measure of depression and is highly correlated with other measures of negative affect (Watson & Clark, 1984).

5.2.3 Procedure

The study was described as a “health and musical preference study” to disguise the alcohol-related focus of the study and to preserve the integrity of the implicit memory association tasks. To help ensure that the alcohol focus of the study remained obscure throughout the testing session, a distracter task was included where participants rated their liking of the music and recorded their preference in musical styles. A validity check question (see Section 4.2.2) was also included to ensure that
the mood prime remained implicit and that the alcohol focus of the study was not revealed.

Testing took place in a quiet, air-conditioned laboratory setting in groups of six participants per session. Each participant sat at a separate desk facing away from other participants. Once informed consent was obtained, participants completed Section 1 of the questionnaire that included baseline mood scale, the Activities Checklist and the BDI. Next, participants were randomly assigned to the positive, negative or neutral conditions according to the desk that they chose to sit at when they first entered the laboratory. Only the experimenter knew which desks were assigned to each condition and desks were rotated through conditions after each testing session. Participants in the mood induction conditions were instructed to put on headphones and listen to the 10-minute selection of music. They were asked to record (on a separate sheet of paper) any thoughts, feelings or images that came to them while they listened to the music. Participants were then instructed to begin Section 2 of the questionnaire when the music finished. Section 2 began with a current mood assessment, immediately followed by the memory association measure. Next, participants completed demographic information, the distracter task, a final mood assessment and the validity check question.

Following this, participants completed Section 3 of the questionnaire comprising the explicit alcohol use measure. During the mood induction procedure, participants in the neutral condition were asked to take a 10-minute break but to remain in the laboratory area. Instructions and measures were otherwise identical to those for participants in the mood induction conditions. On the validity check question (see Section 4.2.2) three students identified the alcohol focus of the study and were dropped from the study sample.
5.3 Results

Participants reported a mean score of 9.21 (SD = 5.2) on the BDI. For the cue-association task, 95 participants (89.6%) recorded at least one alcohol-related response. Eleven participants (10.4% of the sample) did not make an alcohol-related response. Forty-eight (45.3%) made one response, 36 (34%) made two responses, 11 (10.4%) made three responses. Overall, the mean number of alcohol-related responses was 1.44 (SD = 0.81) from a possible range of 0 to 5. One-way ANOVA analysis showed that there were no significant differences in the number of alcohol-related responses across the four permutations of the cue-association task (see Section 3.2.1.2.2).

5.3.1 Manipulation checks

Prior to further analysis, negative affect ratings were submitted to a square root transform to reduce skewness (Tabachnick & Fidell, 1999). A between groups ANOVA analysis showed there were no differences between the positive, negative and neutral mood conditions at baseline on measures of alcohol consumption, age, BDI scores, memory associations, and mood ratings. Chi-squared analysis showed no differences for the gender variable across mood conditions. To investigate the effectiveness of the mood manipulation, two 3 (mood condition) by 3 (time: baseline, mood induction, and study completion) repeated measures ANOVAs were used with time as the within subjects factor and ratings of mood (positive /negative) on the analogue scale as the dependent variables. Figure 5.1 shows significant interactions between mood condition and time for positive affect ratings $F(2, 103) = 21.52, p < .001$, and for negative affect ratings $F(2, 103) = 22.79, p < .001$. As expected, there were no significant changes in affect ratings across time for participants who spent 10
minutes in a casual waiting room in the neutral (control) condition and these data are omitted from the figure.

![Graph showing significant interactions between mood condition and time.](image)

*Figure 5.1.* Significant interactions between mood condition and time (N = 106).
Mean positive affect ratings and simple effects analysis across time for experimental conditions are presented in Table 5.1. For participants in the positive mood induction, positive affect ratings significantly increased from baseline to mood induction and negative affect significantly fell from baseline to mood induction. This decrease in negative affect during the positive mood induction remained significantly different from baseline at completion of the study measures.

Table 5.2 shows mean negative affect ratings and simple effects analysis across time for experimental conditions. Participants in the negative mood induction significantly increased their negative affect ratings from baseline to mood induction and significantly decreased their positive affect ratings from baseline to mood induction. The decrease in positive mood ratings in the negative mood induction condition continued to be significantly different from baseline at study completion. All other affect ratings returned to near baseline levels. However, it took participants approximately 15 minutes to complete the study before responding to the final affect rating measure and mood induction effects may have dissipated over this time. Importantly, key memory association measures were completed in the first few minutes immediately following the mood induction. This ensured that memory accessibility measures were completed in the context of differential mood.
Table 5.1

*Mean Positive Affect Ratings across Time by Mood Induction Condition*

<table>
<thead>
<tr>
<th>Mood Induction condition</th>
<th>Baseline (positive affect)</th>
<th>Mood induction (positive affect)</th>
<th>Study completion (positive affect)</th>
<th>F ratios (2, 103)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>69.2 (18.8)</td>
<td>78.7 (20.3)***</td>
<td>71.8 (22.1)</td>
<td>3.73*</td>
</tr>
<tr>
<td>Negative</td>
<td>70.4 (19.5)</td>
<td>51.2 (21.9)***</td>
<td>59.6 (24.1)***</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>70.1 (23.8)</td>
<td>70.8 (23.8)</td>
<td>70.8 (23.6)</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* N = 106. ***p < .001 **p < .01. *p < .05. Significant differences in mean positive affect ratings from baseline to mood induction and baseline to study completion.
Table 5.2

*Mean Negative Affect Ratings across Time by Mood Induction Condition*

<table>
<thead>
<tr>
<th>Mood Induction condition</th>
<th>Baseline (negative affect)</th>
<th>Mood induction (negative affect)</th>
<th>Study completion (negative affect)</th>
<th>F ratios (2, 103)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>35.7 (18.1)</td>
<td>25.3 (15.8)**</td>
<td>29.1 (16.7)**</td>
<td>4.56*</td>
</tr>
<tr>
<td>Negative</td>
<td>33.8 (20.9)</td>
<td>48.1 (22.2)**</td>
<td>34.6 (22.7)</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>28.3 (21.5)</td>
<td>27.6 (21.0)</td>
<td>27.7 (20.5)</td>
<td></td>
</tr>
</tbody>
</table>

Note. N = 106. **p < .001  *p < .05. Significant differences in mean negative affect ratings from baseline to mood induction and baseline to study completion.
5.3.2 Predicting alcohol-related accessibility

A series of four hierarchical regression analyses were conducted to examine the relationships between changes in mood, drinking, and the accessibility of alcohol-related memory associations. Correlations between variables in the models are presented in Table 5.3. In regression Model 1 (drinking quantity/positive mood change model) measures of quantity of drinking were entered on Step 1, while baseline positive affect was entered on Step 2. Next, post mood induction positive affect was entered on Step 3. To assess the interaction of increases in positive mood ratings and drinking quantity on memory accessibility, the two-way interaction term between quantity of drinking and post mood induction positive affect was entered on Step 4. In Model 2 (drinking quantity/negative mood model) drinking quantity was entered on Step 1, followed by baseline negative affect on Step 2, post mood induction negative affect on Step 3, and the two-way interaction term between quantity of drinking and post mood induction negative affect on Step 4. Models 3 and 4 assessed identical relationships only substituting frequency of drinking. This method tested the hypothesis that for those participants who increased their positive or negative mood in the appropriate mood manipulation and who were heavier or more frequent drinkers would show effects of mood context on alcohol-related accessibility.
Table 5.3

*Correlations between Variables of Interest (N = 106)*

<table>
<thead>
<tr>
<th></th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
<th>7.</th>
<th>8.</th>
<th>9.</th>
<th>10.</th>
<th>11.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Total memory associations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Drinking frequency</td>
<td>.304**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Drinking quantity</td>
<td>.331**</td>
<td>.660**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Mean baseline positive affect</td>
<td>.105</td>
<td>.122</td>
<td>.153</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Mean post mood induction positive affect</td>
<td>.078</td>
<td>.057</td>
<td>.035</td>
<td>.686**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Mean baseline negative affect</td>
<td>-.172</td>
<td>-.156</td>
<td>-.164</td>
<td>-.542**</td>
<td>-.323**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Mean post mood induction negative affect</td>
<td>.064</td>
<td>.024</td>
<td>.009</td>
<td>-.353**</td>
<td>-.549**</td>
<td>.766**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Interaction term: quantity by mood induction positive affect</td>
<td>.298**</td>
<td>.568**</td>
<td>.869**</td>
<td>.328**</td>
<td>.387**</td>
<td>-.228*</td>
<td>-.198*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Interaction term: frequency by mood induction positive affect</td>
<td>.255**</td>
<td>.833**</td>
<td>.511**</td>
<td>.385**</td>
<td>.507**</td>
<td>-.253**</td>
<td>-.271**</td>
<td>.680**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Interaction term: quantity by mood induction negative affect</td>
<td>.303**</td>
<td>.567**</td>
<td>.879**</td>
<td>.057</td>
<td>-.187*</td>
<td>.086</td>
<td>.360**</td>
<td>.611**</td>
<td>.296**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Interaction term: frequency by mood induction negative affect</td>
<td>.252**</td>
<td>.817**</td>
<td>.557**</td>
<td>-.031</td>
<td>-.228*</td>
<td>.213*</td>
<td>.471**</td>
<td>.330**</td>
<td>.507**</td>
<td>.724*</td>
<td></td>
</tr>
</tbody>
</table>

*Note.*  
* Correlation is significant at the 0.05 level (one-tailed).  
** Correlation is significant at the 0.01 level (one-tailed).
For those participants who showed increases in their positive affect ratings from baseline to post mood induction (N = 32), Model 1 (drinking quantity/positive mood model) accounted for 38% of the variance in memory accessibility $F(4, 27) = 4.61, p < .01$. At Step 1, quantity of drinking was a significant predictor of accessibility. Neither baseline positive affect nor post mood-induction positive affect predicted accessibility at Steps 2 and 3. At Step 4, the interaction term significantly predicted accessibility of alcohol-related memory ($\beta = 2.60, p < .01$). Results of Model 1 are presented in Table 5.4. Figure 5.2 indicates that the relationships between variables in the model were in the expected direction.

Model 2 (drinking quantity/ negative mood model) accounted for 45% of the variance in memory accessibility $F(4, 27) = 3.74, p < .05)$. However, quantity of drinking at Step 1 ($R^2 = .44)$ was the only significant predictor of memory accessibility in the model ($\beta = .67, p < .001$). Similar results were found for Model 4 (drinking frequency /negative mood model). While the whole model accounted for 30% of variance in memory accessibility $F(4, 27) = 2.76, p < .05)$, frequency of drinking explained most of this variability ($R^2 = .27$) and was the only significant predictor ($\beta = .51, p < .01$). Model 3 (drinking frequency /positive mood model) was not a significant predictor of accessibility.
Table 5.4

*Hierarchical Regression of Drinking Quantity, Mean Positive Affect (Baseline & Postmood) and Two Way Interaction Term on Memory Accessibility (N = 32).*

<table>
<thead>
<tr>
<th>Variables</th>
<th>$R^2$</th>
<th>$R^2$ Change</th>
<th>$F$ Change Value</th>
<th>dfs</th>
<th>Beta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory Accessibility</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 1. Drinking Quantity</td>
<td>.16</td>
<td>.16</td>
<td>5.62*</td>
<td>30</td>
<td>.40*</td>
</tr>
<tr>
<td>Step 2. Baseline Positive Affect</td>
<td>.17</td>
<td>.01</td>
<td>.41</td>
<td>29</td>
<td>.11</td>
</tr>
<tr>
<td>Step 3. Postmood Positive Affect</td>
<td>.21</td>
<td>.04</td>
<td>1.54</td>
<td>28</td>
<td>.46</td>
</tr>
<tr>
<td>Step 4. Interaction Term</td>
<td>.38</td>
<td>.16</td>
<td>6.78**</td>
<td>27</td>
<td>2.25**</td>
</tr>
</tbody>
</table>

*Notes.* Beta values are standardised regression coefficients taken from each step in the model. * $p < .05$. ** $p < .01$.  

Figure 5.2. Three-way plot indicating positive direction of the relationship between accessibility, post mood induction positive affect and drinking quantity (N = 32).

5.4 Discussion

The aim of the present study was to investigate the effects of mood on accessibility of alcohol-related memory associations among undergraduate drinkers. It was proposed that an interaction would exist between chronic and contextual accessibility such that increased positive or negative mood would facilitate accessibility for alcohol-related memory in more experienced drinkers. Present results supported the hypothesis that there would be an interaction between alcohol use and mood in the prediction of accessibility. However significant findings were limited to measures of quantity of drinking among those participants who showed increased positive mood.
These data indicate that internal, contextual cues (positive affect) may interact with chronic accessibility of alcohol-related memory to help explain individual differences in drinking. From a memory network-based perspective, results suggest that associations in memory between positive mood and drinking are relatively strong among undergraduates. This may reflect findings that undergraduate drinking primarily takes place in social situations (Jones, 2003), and that drinking in social contexts is associated with enhancement of positive mood (Carrigan, Samoluk, & Stewart, 1998; Fromme & Dunn, 1995). In addition, when undergraduates are asked to list positive outcomes of drinking, enhanced sociability is a high frequency response (Leigh & Stacy, 1994).

A further observation was that significant interactions for positive affect were limited to quantity and not frequency of drinking measures. However, accessibility was a better predictor of frequency of drinking in Study 1. One likely explanation for this apparent contradiction is that a typical pattern of undergraduate alcohol use is heavy episodic drinking, often at parties or in the context of other celebrations and social events organised by student bodies (Jones, 2003; Roche & Watt, 1999). An associative memory approach posits that affective features of an individual’s experience with drinking are encoded in parallel with other contextual features of the use situation (Bower, 1992; Hintzman, 1986). To the extent that associative responses to ambiguous cues also tap into associations between behaviour and its related affective features, then positive affect and quantity of alcohol consumption may form a salient association in memory among undergraduate drinkers, strengthening connections between heavy consumption and positive mood. While initiating a drinking session (frequency) may be associated in memory with a range of environmental and positive or negative affective cues, the
particular pattern of undergraduate consumption in the presence of enhanced positive mood could explain why positive mood and drinking quantity interacted to predict memory accessibility rather than frequency of drinking.

No effects were found for students who showed increases in negative mood. Results for negative mood are inconsistent with models that postulate negative affect alleviation (e.g., tension reduction) as a principal motivator for alcohol consumption (Cox & Klinger, 1998). One explanation for this finding may lie in the nature of the negative mood manipulation. It is possible that the negative mood induction failed to induce valid stress states including nervousness and anxiety that have been associated with drinking in previous studies (e.g., Swendsen, et al. 2000). Researchers have also argued that a failure to employ valid stressors in experimental studies has contributed to the mixed and modest support for the tension reduction hypothesis in general (Greely & Oei, 1999). A second explanation is that although participants who received the negative mood induction showed a significant increase in negative mood, baseline positive mood across all conditions was relatively high (M = 70, SD = 21; Range = 0 to 100). The effect of negative mood on accessibility of alcohol-related memory may be more consistent with coping theory models of drinking in a sample of more depressed individuals.

5.4.1 Limitations and conclusions

Though existing memory activation paradigms were extended to investigate the affective contexts under which implicit alcohol-related memories are retrieved, the method did not account for the subjective valence of implicit associations. It is possible that for those with readily activated alcohol-related memory networks, the networks may include negative or positive affect “nodes” (Stacy, 1995) and that such information may
facilitate approach or avoidance of drinking. Future studies could investigate whether positive and negative implicit alcohol-related associations vary according to mood context. While the present study investigated the role of context on accessibility among undergraduates, it may be that the interaction between contextual (in this case affective) and chronic accessibility varies in different age groups or as individual’s progress in their drinking careers.

Overall, results support the proposition that substance-related memory networks may include associations between contextual, affective elements and substance use. These affective associations may interact with chronic accessibility of alcohol-related memory to differentially affect the ease with which alcohol-related associations are accessed. These findings are particularly salient given that accessibility was measured using a single cue-association measure. Despite evidence for the significance of mood state in motivating the initiation and maintenance of alcohol consumption, exploration of relationships between mood specific implicit memory processes and accessibility for alcohol-related memory has received limited attention in the research literature. Further exploration of interactions between chronic and contextual accessibility of alcohol associations may help to develop cognitive models of individual risk for problem drinking. Finally, more research is needed to investigate the extent and nature of affective information that may be implicitly represented in substance-related memory networks.
CHAPTER SIX

Final Discussion
6.1 Summary of findings

6.1.1 Overview

In this program of research, three primary studies were conducted. Study 1 used structural equations modelling to explore differential effects of alcohol-related memory accessibility on quantity and frequency dimensions of drinking. Study 2 investigated longitudinal, cross-lagged relationships between accessibility and alcohol consumption across three waves of data over a one-year period. Lastly, Study 3 used an experimental design to assess whether enhancement of positive or negative mood would differentially predict accessibility of alcohol-related memory in undergraduate drinkers.

6.1.2 Study 1

The aim of Study 1 was to assess whether the relationship between alcohol-related memory accessibility and heavy drinking would be mediated by the frequency of drinking sessions. Initial results confirmed earlier studies (e.g., Stacy, 1995) that alcohol-related memory accessibility can reliably predict undergraduate drinking behaviours (average use and heavy episodic drinking) over and above background variables of age, gender and sensation seeking cross-sectionally. Further investigation of the relationships among these variables included novel analysis of the role of memory accessibility on quantity and frequency dimensions of drinking behaviour. Results of structural equations modelling showed that the influence of memory accessibility on heavy drinking was partially mediated by frequency of drinking. These findings indicated that implicit alcohol-related cognitions may play a greater role in decisions to initiate drinking than in the quantity consumed at each session.

6.1.3 Study 2
Study 2 set out to examine prospective relationships between accessibility of alcohol-related memory associations and alcohol use in undergraduate drinkers. Longitudinal cross-lagged models showed that memory activation predicted drinking and drinking predicted memory activation over a one-year period. Although not all cross-lagged pathways were significant at every time point, results support suggestions that memory activation may be interpreted as either a predictor or a product of alcohol use. This finding corroborates previous arguments that the pattern of activation of alcohol-related memory associations influences drinking behaviour, which in turn influences memory associations (Stacy, 1995; 1997).

A secondary aim of Study 2 was to test the hypothesis that implicit and explicit measures of alcohol-related memory might reflect separate memory constructs that predict drinking independently. To investigate this issue, differential prediction of drinking by implicit (cue-association) and explicit (outcome expectancy) measures was assessed at the third wave of data collection. However, explicit expectancies did not independently predict drinking in the regression models. There appears to be significant heterogeneity in the association of expectancy content and drinking behaviour (see Section 1.7.3) and it is not clear why expectancy domains have been found to be inconsistent predictors of drinking across individuals and studies (Leigh & Stacy, 1991). Indeed, inspection of correlations showed that both memory accessibility and expectancies were significantly positively correlated with drinking measures, but not with each other. This suggests at least partial support for the notion that implicit and explicit memory measures may be independently associated with drinking and may reflect separate memory constructs.
6.1.4 Study 3

Study 3 used an experimental design to investigate the effects of context on accessibility of alcohol-related memory networks. To do this, affective contexts previously associated with drinking (positive and negative mood) were manipulated in a laboratory setting immediately prior to completion of memory association measures. This study sought to explain individual differences in drinking behaviour that may result from effects of context on activation of alcohol-related memory networks.

Results showed that positive mood facilitated accessibility of memory associations in more experienced drinkers. This finding supports the proposition that memory and mood states may be linked via associative nodes and responses to ambiguous cues in memory association tasks may tap into associations between behaviour and its related affective features (Bower, 1981). In this way, an internal contextual cue (e.g., positive affect) may interact with chronic accessibility to predict individual differences in drinking.

6.1.5 Preliminary studies

Before embarking on the research above, two preliminary studies were conducted to optimise the predictive power of existing memory association tasks. The refinement process identified a set of ambiguous cues that best predicted drinking in Australian students. This finding suggests that choice of word cues in memory association tasks may impact on the power of the task to predict drinking behaviours. Set size effects (e.g., Nelson et al., 1992) were outlined as a probable mechanism by which this may occur. The refinement of the cue-association measure was an important and necessary starting
point to this research and should facilitate future alcohol-related implicit cognitions research among young Australian adults.

6.2 Research implications

6.2.1 Implicit cognitions and environmental models of drinking

6.2.1.1 Social learning and formative memory associations

Results from the present research (Kelly et al., in press), and previous studies (e.g., Stacy, 1997), suggest that once formative associations in memory are made between drug use and related cues and outcomes, a bi-directional relationship exists between accessibility and use. Formative drug-related memory associations may occur vicariously via social learning processes (Bandura, 1984), and provided alcohol use has taken place, it would be reasonable to assume that the strengthening of associations in memory between use and affective cues and outcomes would be influenced by various individual differences and unique learning history. Consistent with this approach, explicit expectancies about the likely outcomes of drinking have been found in young children (aged three to six years; Zuckner, et al., 1995; Miller, et al., 1990), as well as adolescents who have not yet tried alcohol (Christiansen & Goldman, 1983; see Section 1.6.1). Thus, children at risk of early uptake of drinking (e.g. those exposed to parental heavy drinking or family dysfunction) might also show evidence of elevated accessibility in memory for alcohol-related associations.

Although I am not aware of any studies that have investigated alcohol-related implicit cognitions in children, memory accessibility predicts drinking in those not much older (i.e., young adolescents; Ames, Sussman, Dent, & Stacy, 2005). It is therefore likely that measures of alcohol-related accessibility (e.g., cue-association task) might be a
useful and unobtrusive screening tool for detecting children who have implicit drinking-related cognitions that place them at risk for early drinking. Given that the cue-association paradigm used in the present study was a short questionnaire and responding does not require abstract conceptualisation, it could generalise well to future research among children. This is important because difficulties were encountered in using more abstract tasks (e.g., outcome-behaviour paradigms) in early pilot studies undertaken by the present researcher among children. Participants were not able to fully grasp what the task required of them and this resulted in either no responses, or responses that were unrelated to the instructional set.

6.2.1.2 Implicit cognitions as mediators of risk variables

Other individual differences that may impact on the relationship between accessibility and drinking relate to a host of variables associated with the development of problem drinking from adolescence to young adulthood (for reviews see Spooner, 1999; Hawkins, Catalano, & Miller, 1992). Briefly, these factors may include impulsivity and sensation seeking (Brennan, Walfish, & Aubuchon, 1986; Sher & Trull, 1994), age of first use (Grant & Dawson, 1998), family dysfunction (Pandina & Schule, 1983), peer and parental drug use (Bucholz, 1990; Wills, Windle, & Cleary, 1998; Webb & Baer, 1995), and genetic heritability (Heath, 1994).

Given the proposed bi-directional relationship between drinking and memory associations, it is likely that at least some of these effects may be mediated by implicit alcohol-related cognitions. For example, given certain environmental learning conditions, a child predisposed to anxiety or depression may be vulnerable to a strengthening of associations in memory between negative affect and drug use (Erblich, Earlywine, &
Erblich, 2001). This could occur via vicarious exposure to drug use in the context of relief of negative affect (e.g., media advertising, discussed later in this chapter) or actual drug use that is found to relieve such affect. Research has shown established links between problem drinking and measures of anxiety and depression in adolescents and young adults (e.g., Willner et al., 1998; Swendsen et al., 2000). In a study of 2,404 young Australians aged 20–24 years living in the Canberra region, hazardous and harmful alcohol consumption was associated with lower levels of positive affect and higher levels of anxiety and depression for both men and women (Caldwell et al., 2004). Regarding younger populations, results from a prospective study of 699 twin girls and 665 twin boys from Minnesota found that depression at age 11 was predictive of alcohol use by age 14 (King, Iacono, & McGue, 2004). These findings are consistent with arguments that negative affective states may act as motivators for coping responses (see Bandura, 1989; Carver & Scheier, 1990) and that negative reinforcement of drug use through reductions in negative affect is both a prepotent and preconscious motivational process (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004).

It is also likely that for anxious or depressed children, drug-use related experiences may result in a reduction of associations in memory to other alternative behaviours. The nature and constraints of anxiety states on learning experiences may limit the range of associations in memory related to negative affect cues. This might have the effect of “concentrating” associations between negative affect and drug use, further biasing behavioural choices towards drug use options. In support of a mediational role for memory activation in drug use, implicit cognitions have been found to mediate the effects of sensation seeking (a biologically based personality trait, Zuckerman, 1993; see Section
3.1), on alcohol and marijuana use in adolescents (Ames et al., 2005) and drug offenders (Ames, Zogg, & Stacy, 2002). Further studies could be undertaken to investigate mediational pathways between accessibility and other antecedent contexts and events to problem drinking behaviour. To investigate these possibilities, implicit cognitions measures could easily be included as mediating variables in environmental models of drug use. This would help to better understand the role of implicit memory processes in the development of problem drug use and how altering implicit processes in interventions may work to mitigate the impact of various risk factors on drug use behaviour.

6.2.2 Implicit cognitions and other drug use

To further the understanding of automatic information processing in addictive behaviours beyond alcohol consumption, future studies could be extended to assess the role of implicit cognitions in motivation for other drug use. While it is reasonable to assume that the cognitive processes underlying drug use might be similar across different drugs (e.g., alcohol & marijuana; see Stacy, 1997), some drugs may vary in potency regarding the establishment of a network of drug-related concepts in memory. For example, high frequency behaviour such as cigarette smoking may lead to a rapid development of smoking-related memory associations and nicotine can have immediate positive psychopharmacological effects (e.g., enhanced cognitive processing and performance, stress dampening, and hedonia, Kassel, 1997). As a result, smoking may be especially amenable to automatisation of cognitive/behavioural processes and this may occur within trying the first few cigarettes (Tiffany, 1990).

There is initial evidence that accessibility for smoking-related memory predicts smoking in adolescents with limited/varying smoking experience (Kelly, Masterman, &
Marlatt, in press b). In this study, a sample of 210 Australian high school students was recruited to assess the extent to which tobacco-related memory accessibility was associated with concurrent tobacco use. Participants completed a cue-association task containing ambiguous tobacco-related targets and a self-report of smoking behaviour. Results showed that accessibility predicted self-use. These initial findings indicate that further studies are needed to address the role of accessibility in the uptake and maintenance of other, relatively common drugs of abuse in young adults (e.g., amphetamines, cocaine; Spooner, 1999) not tested in the present research program.

6.2.3 Subjective valence of implicit cognitions

The present program of research did not investigate the subjective valence of implicit memory associations. It is possible that the experience of positive or negative consequences of drinking may modify associations in memory that guide future drinking. In people with chronically accessible alcohol-related memory networks, the network may include negative or positive affect “nodes” (Stacy, 1995) and activation of these concepts may impact on approach or avoidance of drinking. For example, a negative mood state may elicit positive memory associations related to reductions in negative affect from drinking. Exploration of such “second order” associations (i.e., ambiguous cue-alcohol-alcohol associations) might be important in design of interventions that seek to enrich or alter drug-related memory networks. Increasing or decreasing the accessibility of positive and/or negative associations in memory could impact differentially on drinking behaviour.

There is limited research on the impact of valence of activated memory nodes on drinking using memory association paradigms. One way of assessing these relationships
would be to administer an outcome-behaviour association task (Stacy et al., 1994; Gadon, et al., 2004; see Section 2.3.1) immediately following a mood induction procedure. By using target outcomes about the good/pleasant things or the bad/unpleasant things that happen when alcohol is consumed, such a task could be used to measure positive and negative activated memory associations in different affective contexts. This would help to further explain the role of affect in alcohol-related memory network activation.

6.3 Clinical implications of the research

Although very little is known about the role of implicit cognitions in the efficacy of prevention and treatment programs, results from the present program of studies support the idea that altering accessibility of alcohol-related information in memory may affect later drinking behaviour. It is therefore likely that interventions that work to modify or revise current associations in memory between cues, attitudes, and alcohol-use outcomes would be important in young adults with drinking problems. Although there is a range of different approaches that may impact on drug use-related cognitive processes, one consciousness-raising intervention likely to influence accessibility of alcohol-related memory is motivational interviewing (MI).

6.3.1 Motivational interviewing and accessibility

When used among high-risk university students, MI has been shown to result in significant statistical and clinical reductions in alcohol-related harm and drinking compared to similar controls at two and four year follow-up (Roberts, Neal, Kivlahan, Baer, & Marlatt, 2000: Baer, Kivlahan, Blume, McNight, & Marlatt, 2001). One way that MI may work is by increasing meta-awareness of substance-related cognitive processes and content normally outside awareness (Miller & Rollnick, 1991). For example, this
approach could allow for early detection of the effects of memory associations between drinking and affective states (e.g., tension) that were previously beyond conscious awareness. Providing clients with an understanding of the ways that implicit cognitive processes may drive drinking decisions could help to strengthen the mitigating effects of executive functions that control the relationship between implicit cognitions and drinking behaviour (Wiers, de Jong, Havermans, & Jelicic, 2004).

Another way that MI might influence implicit cognitions is via addressing ambivalence to change. One of the most important features of MI is the systematic eliciting from the client of their beliefs about the positive and negative consequences of drinking (Miller & Rollnick, 1991). Any concerns raised about the negative consequences of continued drinking would represent the client’s expectations of future problems based on their current experience. By facilitating such insight through the development of discrepancies between current behaviour and goals (Miller & Rollnick, 1991), MI may work to increase accessibility for negative alcohol-related cognitions. One study has shown that heavier drinking in undergraduates is related to more varied and ambivalent associations in memory regarding the outcomes of drinking (Kelly & Witkiewitz, 2003). This was evidenced by slower reaction times to attitudinal enquiries about the positive and negative effects of alcohol. These authors argue that because MI is designed to reduce ambivalence by allowing the client to develop their own arguments for change, it may work to alter mixed and conflicting associations in memory that influence drinking decisions.

While these mechanisms have not been substantiated, the processes of self reflection, insight building and self-efficacy in MI may target relevant affective
experiences that have become associated in memory with alcohol use. The alternative associations made during MI may then become automatically activated in high-risk situations to influence decision-making away from further drinking. Given the likely links between the processes of MI and changes in implicit cognitions, it would be of interest to examine how accessibility might change as a consequence of an MI program. One methodology would be to compare how MI impacts implicit cognitions relative to another intervention (e.g., standard education; SE) less likely to influence memory accessibility. While SE could conceivably have some effect on implicit processes, it does not involve the processes outlined in MI that have been conceptually associated with alteration of memory network activation. Such comparisons between interventions could help to substantiate the role of implicit cognitive processes in behaviour change following effective consciousness-raising interventions.

6.3.2 Experiential explicit expectancy challenges

The process of experiential learning undertaken during existing cognitive interventions such as expectancy challenges (Darkes & Goldman, 1993; 1998) could also be applied to implicit cognitions. That is, through such experiential learning paradigms, it is likely that individuals could expand “second order” memory associations via inclusion of an insight-oriented focus on cognitive processes that may normally be outside of awareness. This could then work to alter accessibility for alcohol-related concepts in memory through attenuation of associations between cues and positive affect outcomes of drinking.

Darkes and Goldman (1993; 1998) were the first to design an expectancy challenge paradigm. In their studies, male social drinkers (college students) received
either two alcoholic drinks or two placebos in a naturalistic drinking context (a bar-lab). While consuming their drinks, participants engaged in social games and following this they were asked to guess who had consumed alcohol and who placebo. Errors in identification provided a basis for highlighting discrepancies between explicit expectancy effects and the actual effects of ethanol ingestion on behaviour. This process is repeated in a second session, followed by a third non-drinking session where the information found in sessions one and two is presented again and discussed. Both studies demonstrated decreases in alcohol consumption and explicit expectancies following the challenge procedure compared to controls.

Although expectancy challenges have produced significant reductions in alcohol use at one-month follow-up (Wiers et al., 2002), changes in implicit cognitions have not been evaluated as predictors of alcohol use. Existing expectancy challenge paradigms show some promising results, however further research could be conducted that included an insight-oriented augmentation. Examination of whether changes in implicit cognitions mediate the effects of the augmented expectancy challenge on later drinking is also needed to demonstrate a causal role for implicit processes in changing alcohol use.

6.3.3 Implicit cognitions and the media

Results from a growing number of studies indicate that alcohol advertising across a range of mediums (e.g., television, magazines, sporting venues) can influence drinking in young adolescents (e.g., Ellickson, Collins, Hambarsoomians, & McCaffrey, 2005; Unger, Schuster, Zogg, Dent, & Stacy, 2003). Advertising campaigns typically contain messages and images portraying positive outcomes of alcohol use in social contexts. Anecdotally, alcohol advertisements often may not include an upfront depiction of an
alcoholic beverage but may present various social scenarios (e.g., tension in the work place, problematic relationships or forming new relationships) that are subsequently resolved with the product. In addition to strengthening associations between social scenarios and positive outcomes of drinking in current drinkers, alcohol advertising may be a potent source of vicarious learning experiences for children. These associations between socialisation and drinking may then easily “pop to mind” in related real-life situations to influence drinking decisions. This is consistent with social learning perspectives that drug use-related memory associations may occur vicariously (see Sections 1.7.1 and 5.1.2).

From an implicit cognitions perspective, media interventions against harmful drinking should also work to form/strengthen associations in memory between alcohol use cues and intervention campaign content. For example, interventions could promote implicit associations between negative outcomes of harmful drinking in certain social situations, or between social scenarios and positive outcomes of non-harmful drinking (or other healthy activities). In either case, to be effective as interventions, activation of these alternative associations must successfully compete with activation of other alcohol-related material in memory in critical situations (Stacy, Ames, & Leigh, 2004).

The extent to which advertising and media influence implicit cognitions, and how these influences transfer to changes in drinking behaviour is largely unknown and is an important topic for further investigation. Initial exploration could include the impact of exposure to alcohol advertising on subsequent responses to a cue-association task across randomised exposure and control groups. The exposure could be disguised by embedding the alcohol advertisements in a range of non-alcohol commercials and framing that part
of the experiment as some alternative evaluation of media content. This approach could help to confirm the role of alcohol advertising in activation of implicit cognitions. Measures of drinking could then be included in mediational analysis to further delineate the effects of advertising on drinking via accessibility of memory associations.

With regard to measuring the direct effects of advertising campaigns on implicit memory, one emerging technique is to assess whether non-verbal content of such campaigns comes spontaneously to mind in response to alcohol cues. One application of this approach is the Sketch-an-Image Test (SIT; Stacy et al., 2004). In this paradigm, following exposure to an intervention program, participants are asked to sketch spontaneous imagery in the context of various drinking cues (e.g., Friday night, having fun). Once completed, sketches are then labelled by participants to clarify their content. The extent to which intervention content has become automatically associated with drinking cues can then be seen via images of skills or alternative behaviours in the sketch. This methodology is not limited to media campaigns and could be applied to any intervention and prevention programs that seek to influence implicit drug-related cognitions.

In sum, discussion presented above suggests that the cognitive processes that underlie drug use may be useful targets for interventions, and that some existing intervention programs may employ methods that result in at least some degree of change in implicit cognitions, although this requires verification. Recently, researchers have begun to suggest particular strategies to enhance the establishment of useable interconnections in memory between intervention program material and cues associated with drug use situations (Stacy, Ames, & Knowlton, 2004). These strategies include
repeated practice of imagery of self-efficacy (e.g., skills, alternative healthy behaviours) in imagined or recreated high-risk situations, elaborations that connect diverse program materials with features of use situations, and assessment and feedback about changes in memory associations. Stacy and colleagues argue that combinations of these components may help to promote interconnections between related concepts in memory that facilitate activation of program-related memories in response to drug use cues. However, research detecting abiding changes in memory associations following such interventions is needed to identify the best strategies for making memories for program content spontaneously accessible in critical drug use situations.

6.4 General limitations

This program of research was limited to undergraduates. Evidence has been presented that undergraduate students may consume more alcohol than their non-student counterparts and be at elevated levels of risk for harm associated with heavy episodic drinking (O’Malley & Johnston, 2002; Roche & Watt, 1999; see Section 1.2). Furthermore, undergraduates’ increased experience with alcohol use might lead to stronger relationships between accessibility and drinking compared to other young adults (Tiffany, 1990). Consequently, results may not generalise to other populations. Nonetheless, present findings may infer the broader role of implicit memory processes in drug use behaviours in general, and further research could verify this suggestion.

The current program of research was based on self-report of alcohol use as a key dependent variable and such self-reports may be subject to response biases. However, the alcohol focus of the research was effectively obscured and confidentiality and anonymity were assured at the time of administration of measures. Under these conditions, self-
reports of drinking have shown reasonable reliability and validity (Knight & Godfrey, 1993, Sobell & Sobell, 1990). While the longitudinal data in this research addressed a number of competing explanations for drinking behaviours, causality cannot be fully determined and it is possible that unforeseen third factors may account for findings.

6.5 Final conclusions

This thesis used an implicit cognitions approach to explain drinking behaviours in undergraduates. In this approach, accessibility of alcohol-related concepts in memory is held to be fundamental to alcohol use motivation. Chronic accessibility, contextual accessibility and their interaction in student drinking was investigated. Overall, the findings suggest that chronic accessibility may be conceptualised as a valid longitudinal predictor or as a product of undergraduate drinking and that implicit memory contributes to an understanding of why students initiate drinking. Furthermore, chronic accessibility may interact with contextual accessibility such that enhancement of positive mood may be associated with increased activation of alcohol-related memory networks in heavier drinkers.

Findings from this thesis highlight the value of a continued focus on implicit cognitions in motivation for alcohol and other drug use. Future research could help to provide valuable new models of susceptibility to problem use based on cognitive antecedents to addiction. Such models have potential application in research that examines mechanisms of change in prevention and treatment efforts.
References


Appendix A

Statement of Student Contribution
Appendix B

Activities Checklist

Instructions:

Listed below are a number of activities that you and your peers may or may not engage in. For each of the activities listed below, please provide a response to the questions asked by circling the answer that is correct as far as you know.

Here is an example question…

**ACTIVITY**

**Rollerblading…**

<table>
<thead>
<tr>
<th>How often do you go rollerblading?</th>
<th>Never</th>
<th>once a month</th>
<th>2-4 times a month</th>
<th>2-3 times a week</th>
<th>4 or more times a week</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the average length of time you spend when you go rollerblading?</td>
<td>Less than an hour</td>
<td>1-2 hours</td>
<td>2-3 hours</td>
<td>4 or more hours</td>
<td></td>
</tr>
<tr>
<td>What was the maximum length of time you spent rollerblading on any single occasion?</td>
<td>1-2 hours</td>
<td>2-3 hours</td>
<td>3-4 hours</td>
<td>5-6 hours</td>
<td>7 or more hours</td>
</tr>
</tbody>
</table>

**PLEASE NOTE:** If you or your peers have not engaged in the activity listed in the last month, please skip to the next activity, and so on. Remember that there are no right or wrong answers. Just answer as accurately as you can.

Now turn the page to complete the following questions in the same way...
ACTIVITY

Eating fast food…

On average, how often do you eat fast food meals?

<table>
<thead>
<tr>
<th>Never</th>
<th>once a month</th>
<th>2-4 times a month</th>
<th>2-3 times a week</th>
<th>4 or more times a week</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What was the maximum number of fast food meals you ate in any one single day?

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
</table>

Over the last month, has your fast food consumption created a health risk for you?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

Eating fast food, best friend …..

On average, how often does your best friend eat fast food meals?

<table>
<thead>
<tr>
<th>Never</th>
<th>once a month</th>
<th>2-4 times a month</th>
<th>2-3 times a week</th>
<th>4 or more times a week</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What was the maximum number of fast food meals they ate in any one single day?

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
</table>

Over the last month, has your best friend’s fast food consumption created a health risk for them?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>
### ACTIVITY

**Doing individual sports or fitness programs (eg: surfing or gym)**

On average, how often do you do individual sports or exercising?

<table>
<thead>
<tr>
<th>Never</th>
<th>once a month</th>
<th>2-4 times a month</th>
<th>2-3 times a week</th>
<th>4 or more times a week</th>
</tr>
</thead>
</table>

What is the *maximum* number of individual sports or exercising sessions you have done in a week?

<table>
<thead>
<tr>
<th>1 - 2</th>
<th>3 - 4</th>
<th>5 - 6</th>
<th>7 or more</th>
</tr>
</thead>
</table>

How often have you done this *maximum* number of sessions?

<table>
<thead>
<tr>
<th>less than monthly</th>
<th>monthly</th>
<th>weekly</th>
</tr>
</thead>
</table>

Over the last month, how often has your sport ever created any problems for you? (eg. travel to sporting venues, injuries, costs etc.)

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never created problems</td>
<td>Sometimes created problems</td>
<td>Often created problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Doing individual sports or fitness programs, best friend ....**

On average, how often does your *best friend* do individual sports or exercising?

<table>
<thead>
<tr>
<th>Never</th>
<th>once a month</th>
<th>2-4 times a month</th>
<th>2-3 times a week</th>
<th>4 or more times a week</th>
</tr>
</thead>
</table>

What is the *maximum* number of individual sports or exercising sessions has your *best friend* done in a week?

<table>
<thead>
<tr>
<th>1 - 2</th>
<th>3 - 4</th>
<th>5 - 6</th>
<th>7 or more</th>
</tr>
</thead>
</table>

How often has your *best friend* done this *maximum* number of sessions?

<table>
<thead>
<tr>
<th>less than monthly</th>
<th>monthly</th>
<th>weekly</th>
</tr>
</thead>
</table>

Over the last month, how often has your friends sport ever created any problems for them? (eg. travel to sporting venues, injuries, costs etc.)

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never created problems</td>
<td>Sometimes created problems</td>
<td>Often created problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**ACTIVITY**

### Drinking alcohol...

**On average, how often do you have a drink containing alcohol?**

<table>
<thead>
<tr>
<th>Never</th>
<th>once a month</th>
<th>2-4 times a month</th>
<th>2-3 times a week</th>
<th>4 or more times a week</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**What is the average number of drinks you have on a day when you are drinking?**

<table>
<thead>
<tr>
<th>1 - 2</th>
<th>3 - 4</th>
<th>5 - 6</th>
<th>7 - 9</th>
<th>10 or more</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**How often do you have six or more drinks on one occasion?**

<table>
<thead>
<tr>
<th>never</th>
<th>Less than monthly</th>
<th>monthly</th>
<th>weekly</th>
<th>Daily or almost daily</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Over the last month, how often has your drinking ever created any problems for you? (eg: with your relationships, friends, parents, with your work/studies or the police etc.)

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never created problems</td>
<td>Sometimes created problems</td>
<td>Often created problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Drinking alcohol, best friend ...

**On average, how often does your best friend have a drink containing alcohol?**

<table>
<thead>
<tr>
<th>Never</th>
<th>once a month</th>
<th>2-4 times a month</th>
<th>2-3 times a week</th>
<th>4 or more times a week</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**What is the average number of drinks your best friend has on a day when they are drinking?**

<table>
<thead>
<tr>
<th>1 - 2</th>
<th>3 - 4</th>
<th>5 - 6</th>
<th>7 - 9</th>
<th>10 or more</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**How often does your best friend have six or more drinks on one occasion?**

<table>
<thead>
<tr>
<th>never</th>
<th>Less than monthly</th>
<th>monthly</th>
<th>weekly</th>
<th>Daily or almost daily</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Over the last month, how often has *one of your close friends* drinking ever created any problems for them? (eg: with their relationships, friends, parents, with work/studies or the police etc.)

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never created problems</td>
<td>Sometimes created problems</td>
<td>Often created problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### ACTIVITY

**Going to the movies…**

On average, how often do you go to the movies?

<table>
<thead>
<tr>
<th>Never</th>
<th>once a month</th>
<th>2-4 times a month</th>
<th>2-3 times a week</th>
<th>4 or more times a week</th>
</tr>
</thead>
</table>

What is the maximum number of times you have gone to the movies in a week?

<table>
<thead>
<tr>
<th>1 - 2</th>
<th>3 - 4</th>
<th>5 - 6</th>
<th>7 - 9</th>
<th>10 or more</th>
</tr>
</thead>
</table>

### ACTIVITY

**Using a computer…**

On average, how many days a week do you use a computer?

<table>
<thead>
<tr>
<th>Never</th>
<th>1-2 days a week</th>
<th>2-3 days a week</th>
<th>4 -5 days a week</th>
<th>Every day of the week</th>
</tr>
</thead>
</table>

What is the average number of hours you spend using a computer per day?

<table>
<thead>
<tr>
<th>1 – 2 hours</th>
<th>3 – 4 hours</th>
<th>5 or more hours</th>
</tr>
</thead>
</table>

### ACTIVITY

**Watching television…**

On average, how many days a week do you watch television?

<table>
<thead>
<tr>
<th>Never</th>
<th>1-2 days a week</th>
<th>2-3 days a week</th>
<th>4 -5 days a week</th>
<th>Every day of the week</th>
</tr>
</thead>
</table>

What is the average number of hours you spend watching television per day?

<table>
<thead>
<tr>
<th>1 - 2</th>
<th>3 - 4</th>
<th>5 - 6</th>
<th>7 - 9</th>
<th>10 or more</th>
</tr>
</thead>
</table>
### ACTIVITY

#### Playing team sport...

On average, how often do you play team sports or games?

<table>
<thead>
<tr>
<th>Never</th>
<th>once a month</th>
<th>2-4 times a month</th>
<th>2-3 times a week</th>
<th>4 or more times a week</th>
</tr>
</thead>
</table>

What is the *maximum* number of team sports or games you have played in a week?

- 1 - 2
- 3 - 4
- 5 - 6
- 7 or more

How often have you played this *maximum* number of games?

<table>
<thead>
<tr>
<th>less than monthly</th>
<th>monthly</th>
<th>weekly</th>
</tr>
</thead>
</table>

Over the last month, how often has your sport ever created any problems for you? (eg. travel to sporting venues, injuries, costs etc.)

<table>
<thead>
<tr>
<th>Never created problems</th>
<th>Sometimes created problems</th>
<th>Often created problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>

#### Playing team sport, best friend ...

On average, how often does your *best friend* play team sports or games?

<table>
<thead>
<tr>
<th>Never</th>
<th>once a month</th>
<th>2-4 times a month</th>
<th>2-3 times a week</th>
<th>4 or more times a week</th>
</tr>
</thead>
</table>

What is the *maximum* number of team sports or games your *best friend* has played in a week?

- 1 - 2
- 3 - 4
- 5 - 6
- 7 or more

How often has your *best friend* played this *maximum* number of games?

<table>
<thead>
<tr>
<th>less than monthly</th>
<th>monthly</th>
<th>weekly</th>
</tr>
</thead>
</table>

Over the last month, how often has your friends sport ever created any problems for them? (eg. travel to sporting venues, injuries, costs etc.)

<table>
<thead>
<tr>
<th>Never created problems</th>
<th>Sometimes created problems</th>
<th>Often created problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>
ACTIVITY

Smoking cigarettes...

On average, how often do you smoke cigarettes?

<table>
<thead>
<tr>
<th>Never</th>
<th>2-4 times a month</th>
<th>2-3 times a week</th>
<th>4-5 times a week</th>
<th>every day</th>
</tr>
</thead>
</table>

What is the average number of cigarettes you have on a day when you are smoking?

<table>
<thead>
<tr>
<th>1 - 2</th>
<th>3 - 5</th>
<th>7-10</th>
<th>15-20</th>
<th>25 or more</th>
</tr>
</thead>
</table>

What is the maximum number of cigarettes you have smoked in a day?

<table>
<thead>
<tr>
<th>1 - 2</th>
<th>3 - 5</th>
<th>7-10</th>
<th>15-20</th>
<th>25 or more</th>
</tr>
</thead>
</table>

How soon after you wake up do you smoke your first cigarette?

<table>
<thead>
<tr>
<th>Within the first 30 minutes</th>
<th>More than 30 minutes after waking but before noon</th>
<th>In the afternoon</th>
<th>in the evening</th>
</tr>
</thead>
</table>

Smoking cigarettes, best friend...

On average, how often does your best friend smoke cigarettes?

<table>
<thead>
<tr>
<th>Never</th>
<th>2-4 times a month</th>
<th>2-3 times a week</th>
<th>4-5 times a week</th>
<th>every day</th>
</tr>
</thead>
</table>

What is the average number of cigarettes your best friend has on a day when they are smoking?

<table>
<thead>
<tr>
<th>1 - 2</th>
<th>3 - 5</th>
<th>7-10</th>
<th>15-20</th>
<th>25 or more</th>
</tr>
</thead>
</table>

What is the maximum number of cigarettes your best friend has smoked in a day?

<table>
<thead>
<tr>
<th>1 - 2</th>
<th>3 - 5</th>
<th>7-10</th>
<th>15-20</th>
<th>25 or more</th>
</tr>
</thead>
</table>

How soon after they wake up does your best friend smoke their first cigarette?

<table>
<thead>
<tr>
<th>Within the first 30 minutes</th>
<th>More than 30 minutes after waking but before noon</th>
<th>In the afternoon</th>
<th>in the evening</th>
</tr>
</thead>
</table>
## ACTIVITY

### Studying and/or doing homework

On average, what amount of time do you spend studying or doing homework per day?

<table>
<thead>
<tr>
<th></th>
<th>none</th>
<th>less than an hour</th>
<th>1-2 hours</th>
<th>3 or more hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What is the *maximum* time you have spent studying or doing homework in a day?

<table>
<thead>
<tr>
<th></th>
<th>1 – 2 hours</th>
<th>3 – 4 hours</th>
<th>5 – 6 hours</th>
<th>7 – 9 hours</th>
<th>10 or more hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

How often have you studied or done homework this *maximum* amount of time?

<table>
<thead>
<tr>
<th></th>
<th>less than monthly</th>
<th>monthly</th>
<th>weekly</th>
<th>daily or almost daily</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Over the last month, has your amount of study/homework created a problem for you?

Yes [ ] No [ ]

---

## ACTIVITY

### Listening to music...

On average, what amount of time do you spend listening to music per day?

<table>
<thead>
<tr>
<th></th>
<th>none</th>
<th>less than an hour</th>
<th>1-2 hours</th>
<th>3 or more hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What is the *maximum* amount of time you have spent listening to music in a day?

<table>
<thead>
<tr>
<th></th>
<th>1 – 2 hours</th>
<th>3 – 4 hours</th>
<th>5 – 6 hours</th>
<th>7 – 9 hours</th>
<th>10 or more hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

How often have you listened to music this *maximum* amount of time?

<table>
<thead>
<tr>
<th></th>
<th>never</th>
<th>less than monthly</th>
<th>monthly</th>
<th>weekly</th>
<th>daily or almost daily</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Appendix C

Explicit Drinking Measure

Please answer the questions below about your own alcohol consumption. Remember your answers are completely anonymous. No one will be able to tell who filled out the form so please be as truthful as possible.

1). Have you ever had any alcohol?   Yes   No

2). If you answered Yes, what age were you when you had your first drink?
   I was ___ years old.

3). Have you had any alcohol to drink in the past month?  Yes   No

4). If you answered Yes, please complete the following questions. If you answered No, please go on to the next questionnaire.

Average Daily Quantity and Frequency

5). For the past month, please put a tick in the box for each day of the week that you usually have a drink. If you usually drink on Wednesday and Saturday then tick those boxes.

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6). Now put a number in the box for each day of the week that you ticked above that shows how many drinks you usually have on that day. If you ticked Wednesday and Saturday above, then put the number of drinks you usually have on those days in their boxes.

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7). Think of the time that you drank the most over the past month. Please circle the answer that best describes how much you drank.

1 1-2 drinks
2 3-4 drinks
3 5-6 drinks
4 7-8 drinks
5 9-10 drinks
6 11-12 drinks
7 13-14 drinks
8 15 or more drinks

One drink is equal to:
- a pot of beer
- a glass of wine
- a nip of spirits

8). How many times have you drunk this amount over the last month?

1 1-2 times
2 3-4 times
3 5-6 times
4 7-8 times
5 8-9 times
6 10-11 times
7 12 or more times
Appendix D

Validity Check Question

Now please answer the following question:

The title you were given for this study was *health and musical preference study*

This was a fairly broad and vague description and didn’t tell you much about what we were doing.

Please write below what you think the main emphasis and goals of the study were. In other words, tell us what you guess the study was about.