Identification of factors that can modify peer group influence on adolescent alcohol use

by

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"The greatest pleasure in life is doing what other people say you cannot do."

– Walter Bagehot

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List of Abbreviations

AIC	Akaike Information Criterion
ANOVA	Analysis of variance
BIC	Bayesian Information Criterion
CTC	Communities That Care
df	Degrees of freedom
EM	Expectation maximisation
ERIC	Education Resources Information Center
GEE	Generalised Estimating Equations
IYDS	International Youth Development Study
LCA	Latent Class Analysis
LTA	Latent Transition Analysis
MANOVA	Multivariate analysis of variance
ML	Maximum likelihood
N	Sample size
NOS	Newcastle-Ottawa Scale
OLS	Ordinary Least Squares
OR	Odds ratio
PDS	Pubertal Development Scale
PPM	Peer Process Model
SD	Standard deviation
SES	Socioeconomic Status
SEM	Structural Equation Models
SSCI	Social Science Citation Index
US	United States of America
χ^2	Chi-square

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Abstract

Adolescent alcohol use is of significant concern given that it is highly prevalent and an important contributor to future health and social problems. Peer groups are known to influence the development of adolescent alcohol use, however, to date there has been insufficient specification of peer processes to enable effective interventions to reduce adolescent alcohol use. This thesis contributed a novel approach to analysing the effect of peer selection and peer influence in the development of adolescent alcohol use. Using a person-oriented approach to analyse longitudinal data from three age cohorts, the sequential contribution of peer selection and peer influence was demonstrated to vary at different stages of adolescence. The study found differences in rates of alcohol use led to differences in some peer processes in two different country contexts, the State of Victoria, Australia and Washington State, the United States of America, which were selected for their distinctly different approaches to adolescent alcohol use policy.

This thesis was initiated with a systematic review of previous longitudinal studies that have included peer processes as main predictors of adolescent alcohol use. As a means of synthesising findings and identifying research gaps, a Peer Process Model (PPM) was developed from this review. The PPM theorised how peer selection and peer influence processes contribute, at different points in adolescent development, to alcohol use and to the common observation of peer aggregation of alcohol users.

Latent class analysis (LCA) and latent transition analysis (LTA) were selected as analytic tools that enable person-oriented analyses of developmental transitions in alcohol use and peer aggregation and hence were considered well-suited for testing the hypotheses implicated by the PPM. The dataset selected for analysis was the longitudinal International Youth Development Study that utilised same sampling methods and procedures to recruit state-representative cohorts

from Grades 5, 7 and 9 in schools in Victoria and Washington State in 2002. Each cohort was prospectively followed up one year later with excellent retention rates (average 99%) providing analytic samples ranging from 875 to 975 students in each cohort.

The LCA and LTA findings did not support a single unitary model for all age cohorts. Peer groupings were simpler in Grades 5 and 6 and more diverse from Grades 7 to 10. Findings revealed some cross-national differences, in that models differed by country with higher levels of alcohol use amongst respondents and their peer groups from earlier ages in Victoria. The majority of early adolescents from Grades 5 to 7 in Washington State were classified as non-drinkers, while 53% had tried alcohol by Grade 5 in Victoria. LCA revealed three latent subgroups in Grade 5 and five in Grades 7 and 9 best-fitted the patterns on indicators of peer associations and alcohol use behaviours in both states. In Victoria by Grade 8, LCA revealed the most prevalent latent subgroup comprised current drinkers who associated with drinking best friends and in the Grade 9 and 10 cohort the most common latent subgroup were binge drinkers (based on reporting recent sessions of heavy alcohol use) who associated with drinking peers. In contrast, by Grade 10, the most prevalent latent subgroup in Washington State remained non-drinkers who associated with drinking peers. The LTA findings were examined to identify transitions congruent with peer selection and peer influence processes at different periods in adolescent development.

Findings from the present study were found to generally accord with predictions arising from the PPM. The PPM posited that peer selection processes tended to precede peer influence and that snowball risk factors (indicated by high levels of family risk factors at an early age) would predict early peer selection transitions. The study findings showed that the higher rates of adolescent alcohol use in Victoria (and the higher levels of family risk factors) were associated with peer selection being only observed in that state. Transitions congruent with peer-influenced alcohol use were not evident in the youngest cohort (Grades 5 and 6) but found to be more common in the older cohorts, with higher proportions of 7th

and 9th graders being observed in trajectories congruent with peer influence processes in Washington State. A finding not anticipated by the PPM was that trajectories congruent with a reverse peer influence process (whereby early alcohol experimenters that have peers who do not use alcohol transition to non-alcohol use) were evident in 19% of the Victorian and 9% of the Washington Grade 5 and 6 cohorts.

A number of statistically significant factors were found to predict Time 1 latent status membership and to moderate one or more transitions congruent with peer processes. Snowball risk factors were assessed using indicators of *Pubertal timing*, *Family history of antisocial behaviour* and *Family conflict*. Snowstorm risk and protective factors (social environmental factors that influence late adolescent alcohol use) were assessed using indicators of *Proportion of drinkers in the classroom*, *Opportunities for prosocial involvement in the family*, and *Opportunities for prosocial involvement at school.*

In line with the PPM, early adolescents (Grade 5) were more likely to be using alcohol in the absence of peers (a necessary pre-condition for peer selection) where they had high levels on snowball risk factors. Transitions congruent with early peer selection were also predicted by snowball risk factors such as *Family history of antisocial behaviour* and to a lesser extent *Family conflict*. Consistent with the PPM, snowstorm risk processes and specifically the aggregation of alcohol-using peers were observed to increase the risk of transitions that were congruent with peer influence.

The study findings reinforce the view that peer processes appear to play an important role in explaining the increasing rates of alcohol use that occur during adolescence. The findings have implications for understanding cross-national similarities and differences in peer processes. Higher levels of alcohol use amongst adolescents and their peers and higher early family risk factors were associated with a greater tendency for peer selection transitions in Victoria. Despite these differences, Victorian and Washington adolescents had a similar

tendency for alcohol use and peer groups to show stability over time, for peer-influenced alcohol use transitions to emerge later in adolescence, and for risk and protective factors to show mostly similar associations in cross-sectional and longitudinal analyses. Implications for alcohol prevention and intervention practice were discussed.

Chapter One: Introduction

The study described in this thesis investigates the role of peer selection and peer influence processes in the development of adolescent alcohol use. The sections that follow introduce the key domains that will form the focus of the investigation and describe the context of the study within the broad field of prevention science. The general introduction provided in this section is followed by a more detailed review of previous literature and a more technical description of concepts and analytic techniques in later sections.

Adolescence is an important life phase where individuals experience enormous changes arising from the developmental effects related to puberty and brain development that lead to attainment of new behaviours and capabilities that enable transitions in different social environments such as family, peer group, and school (Viner et al., 2012). Most adolescents have started the rapid changes of puberty by age 12, which is initiated by a series of hormonal changes. Physical differences between boys and girls become apparent as early adolescents experience growth spurts which result in visible changes in body composition and development of secondary sexual characteristics (Windle et al., 2008). Pubertal transitions coincide with other important transitions in the social context, such as transitions from primary to secondary school that provide opportunities to establish relationships with new teachers and peers; and in the family context, such as the increased time spent outside of the home that reduces direct supervision of the adolescent by their parents or caregivers. Adolescence is also a period when developmental tasks include changes in self and sexual identities. A balanced view of one's strengths and weakness is achieved through successful completion of developmental tasks such as secure attachment, clear sense of identity, and self-competence. If these developmental challenges are not met, early adolescents are less likely to make well-reasoned choices based on internal values and standards which is a primary source of adolescent behavioural problems (Catalano, Hawkins, Berglund, Pollard, & Arthur, 2002). In fact, many

health risk behaviours, including alcohol use, first emerge during the second decade of life (e.g. Catalano et al., 2012; Zucker, Donovan, Masten, Mattson, & Moss, 2008). As self-identity choices and relationships with peers each become increasingly important during this period, some young people are more likely to initiate substance use due to their peers' preference and influence. In some cases adolescent risk taking may increase popularity - past studies have demonstrated that adolescents' engagement in health risk behaviours was associated longitudinally with increases in peer status (Heilbron & Prinstein, 2008).

Previous research has shown that having substance-using friends is a key proximal factor for the initiation of substance use among adolescents (e.g. Kandel, 1996; Oetting & Beauvais, 1986). Peers are believed to contribute to the initiation of adolescent substance use through complex socialisation processes directly and indirectly. These peer influence mechanisms include modelling of substance use, shaping attitudes and norms, reinforcing use, overt peer pressure and persuasion, and provision of substance and support for drug use (Bauman & Ennett, 1996; Knecht, Snijders, Baerveldt, Steglich, & Raub, 2010). Moreover, adolescents tend to associate with others who are similar to themselves as interactions with similar peers may be especially rewarding. A sense of familiarity and attraction and behavioural confirmation of personal thoughts and feelings can be generated through these interactions (Knecht, Burk, Weesie, & Steglich, 2011). Substance use may serve as a social function for the development of friendships and maintenance of peer bonding; if adolescents initiate substance use, new social opportunities become available such as new friendships and admission to social contexts where use is common (e.g. parties; Poulin, Kiesner, Pedersen, & Dishion, 2011). When friendships are formed based on the similarity of common drug behaviour, i.e., substance users seek out other users to be friends, selection rather than influence contribute to the association between peers and adolescent substance use (Bauman & Ennett, 1996). Similarity may be shaped by both peer influence and peer selection processes and the relation between substance use and peers may be bi-directional (Knecht et al., 2010; Poulin et al., 2011). Adolescents who have social skills deficits tend to have less choice of friends due to both their

inability to enter popular peer social networks and rejection by peers. These individuals are more vulnerable to selecting less-popular antisocial peers, which increases their likelihood of initiating substance use. Hence, both influence and selection processes partly contribute to peer similarity in antisocial behaviours including substance use. The issues associated with peer influence and selection that represent the independent variable analysed in the current study are described in greater detail in the literature review presented later in Section 1.1.

The sections that follow briefly summarise the cross-national and social context of adolescent alcohol use that will be the key dependent variable examined in the empirical study. The literature review presented in Section 1.1 describes in greater detail the issues that underlie concern regarding adolescent alcohol use. Despite declines over the past decade, alcohol use is prevalent during adolescence and remains a significant public health concern in all western countries (Simons-Morton, Pickett, Boyce, ter Bogt, & Vollebergh, 2010). Not only is early initiation of alcohol use damaging to physical health in adolescence, it also increases the likelihood of heavy and harmful alcohol use and subsequent illicit drug use (Mason et al., 2011; Poulin et al., 2011). Therefore, it is important to monitor youth alcohol and substance using behaviours.

Rates of adolescent alcohol use are likely to vary across country contexts due to the different cultural practices, drug laws and policies adopted by different countries. Countries that emphasise zero-tolerance policies such as the United States of America (US), seek to encourage adolescent abstinence from alcohol and drug use. These policies include severe laws and regulations for alcohol and drug use, purchase and supply and the threat of severe consequences for legal violations including arrest and heavy penalties. With respect to adolescent alcohol use, such approaches are characterised by a higher legal age for purchasing and using alcohol (age 21 in the US compared to 18 in Australia), abstinence alcohol education messages and the greater use of school exclusion and police arrest for school-age alcohol violations (Evans-Whipp, Bond, Toumbourou, & Catalano, 2007). These differences are associated with lower

adolescent alcohol use (referred to also in this thesis as drinking rates) in the US compared to other western nations (McMorris, Catalano, Kim, Toumbourou, & Hemphill, 2011; Simons-Morton et al., 2010).

Adolescent alcohol use is more prevalent in countries such as Australia that adopt harm-minimisation policies that aim to minimise the harm to individuals and the cost to society of enforcement, incarceration, and their related loss of productivity (Simons-Morton et al., 2010). For example, in Australia, advocates of harm-minimisation policies suggest that experimentation with alcohol use is a normal part of adolescent development and advocates contend that exposure to drinking supervised by parents or other adults may help youth learn responsible drinking (Ward & Snow, 2011).

Toumbourou and colleagues (2009) compared drinking prevalence in two states in Australia (the State of Victoria) and the US (Washington State) in 2002. Higher rates of alcohol use in the past month were found among 9th graders (average age 13) in Australia compared to their counterparts in the same grade level in the US (55% of Australian girls vs. 26% of American girls; 53% Australian boys vs. 23% American boys). Simons-Morton and colleagues (2010) conducted another study examining the alcohol use rates among 10th graders in the US, Canada, and the Netherlands, countries with different approaches regarding adolescent alcohol use. In particular, laws and policies are relatively strict in the US, while the Netherlands employs a harm-reduction policy that is similar to that of Australia. Canadian policies fall in between with federal laws similar to that of the US and enforcement practices consistent with harm reduction. Prevalence of drinking in the past month was found to be highest in the Netherlands followed by Canada and then the US; 68% of boys and 56% of girls in the Netherlands, 44% of boys and 45% of girls in Canada, 34% of boys and 29% of girls in the US reported having used alcohol in the past month. Cross-national comparisons of rates of adolescent alcohol use enable researchers to investigate underlying factors that explain similarities and differences in the prevalence of adolescent alcohol use in different countries (McMorris, Hemphill, Toumbourou, Catalano, & Patton,

2007). Given that most research on preventive interventions to reduce adolescent alcohol and drug use have been conducted in the US, cross-national studies that establish similarities and differences with the US are essential (Toumbourou et al., 2009).

Efforts to prevent adolescent health and social problems such as alcohol use by studying life-course and epidemiological data and intervention, policy and dissemination evaluations are increasingly referred to as "prevention science". Prevention science draws on basic and applied research from many disciplines including psychology, public health, education, psychiatry, social work, medicine, and economics (Weissberg, Kumpfer, & Seligman, 2003). The goal of prevention science is to use evidence-based approaches to prevent or moderate major human health and social problems and encourage optimal functioning through a focus on eliminating or mitigating the modifiable causes of problems at a whole-population level. A common approach to prevention science is to use longitudinal, observational and clinical data to identify the aetiological processes that underlie the development of disease states, health and social problems. Laboratory, intervention and experimental studies that manipulate or statistically control posited aetiological processes are used to identify causal agents. Efficacy, effectiveness and dissemination evaluations are used to identify actions, programs and policies that may reduce causal factors and contribute to population reductions in targeted health and social problems (Flay et al., 2005).

Prevention policies and programs have been described in different ways. Within preventive medicine a traditional definition of disease prevention distinguishes between primary, secondary, and tertiary prevention (Nightingale, 1978). Primary prevention includes actions to decrease the number of new disease cases. Secondary prevention involves early identification and efficient treatment to limit harm in the early stages of a disorder and to lower the prevalence of established cases. Tertiary prevention aims to provide treatment to reduce the severity of disability associated with an existing disorder (Weissberg et al., 2003). Gordon (1983) conceptualised prevention more broadly as addressing

aetiological or developmental causes that lead to disorders. In this conceptualisation prevention can be addressed through universal, selective or indicated interventions. While the target of universal preventive interventions is the whole population irrespective of risk, selective preventive interventions target groups with increased risks of poor outcomes and indicative preventive interventions target individuals who are already showing symptoms of disorder (Catalano et al., 2012).

In order for prevention efforts to be applied before an illness or disorder is fully established, prevention research needs to focus on the systematic study of potential antecedents and or causes of disorder (Coie et al., 1993). Before aetiological processes are more fully understood, antecedents can be identified as "predictors" where they account for a higher statistical probability of onset, greater severity and or longer duration of disease states or health and social problems (such as adolescent health risk behaviours). Predictors that maintain statistically significant effects after adjustment for known developmental influences (referred to in epidemiology as confounders) are defined here as "risk factors". In contrast, "protective factors" can be defined as variables that moderate, mediate and or mitigate risk factors to improve people's resistance to risk exposure.

The present study is located within the area of risk process identification that forms one area of study within the broader field of prevention science. Within the field of prevention science a common aim of preventive interventions is to disrupt the life-course processes that contribute to the development of health and social problems by reducing risk factors and by strengthening protective factors. Within this approach, basic research investigating risk and protective factors is an important source of information for informing the design of preventive interventions. The likelihood of desirable adolescent health outcomes can be improved by widely-implementing effective prevention efforts (Catalano et al., 2012).

Adolescent development is an ongoing process that is influenced by biogenetic factors and pre-natal, childhood and adolescent experiences. Adolescent behaviours are subjected to influences from multiple social contexts such as family, school, peer group, and community influences that may have varying impacts at different points of development (Coie et al., 1993). The salience of risk factors may fluctuate developmentally; research has shown that different risk and protective factors are most relevant at specific stages of development (Catalano et al., 2002). Prevention science research explicitly addresses the complex biopsychosocial processes that contribute to the incidence and prevalence of health and social problems (Weissberg et al., 2003). To ensure appropriate preventive intervention matches the target group's developmental stage and environment, researchers need to investigate developmental processes within different environmental contexts (Catalano et al., 2002). Researchers also need to model and theorise developmental processes to postulate how specific interventions are expected to influence risk and protective processes to ultimately reduce health and social problems.

In efforts to identify aetiology it is important to examine whether developmental processes are culturally invariant or show variation across different age periods and in different cultural groups. As identified in earlier sections there are important cross-national differences in policies addressing adolescent alcohol use and in rates of adolescent alcohol behaviours. In recent studies early age alcohol use (Mason et al., 2011) and parental-supervised alcohol use (McMorris et al., 2011) have each been shown to be cross-nationally similar risk factors for progression to heavy alcohol use in Australia and the US. However, it is also plausible that behaviours and experiences considered to be adaptive, normative, or deviant in one culture may not be perceived the same way in other cultures (Coie et al., 1993), suggesting that not all risk factors will be culturally similar. Effective intervention programs are those that are tailored to the cultural, community, and the developmental context of program participants (Weissberg et al., 2003).

Longitudinal (prospective) investigations that observe children and adolescents across the life-course enable the study of the emergence and progression of adolescent alcohol use behaviour and can also be used to study the processes by which risk factors and protective factors influence these behaviours. Longitudinal studies provide the ability to identify predictors of youth drinking, as well as factors that moderate and/or mediate the processes that lead to progression of alcohol use. By monitoring cohorts of nationally representative samples in different countries and by measuring influences from different contexts, a more universal picture of the developmental pattern and aetiological influences underlying specific disorders emerges (Coie et al., 1993).

The present study uses longitudinal data to examine peer processes in the development of adolescent alcohol use. The literature review in Section 1.1 provides an extended discussion of the quality issues that affect the analysis of data from longitudinal studies. The sections that follow provide a general introduction to the approach to longitudinal data analysis adopted in the present study. In recent times many innovative statistical methods have been applied to the identification of the development and prediction of substance use behaviour within longitudinal research (Kaplan, 2008; MacKinnon & Lockwood, 2003). Commonly used statistical methods, such as regression analysis and structural equation modelling, take a variable-oriented approach to identify predictive associations between variables. Person-oriented approaches seek to identify heterogeneous groups that include individuals with similar response profiles across the course of their development. For example, in alcohol research, researchers often seek to group individuals into categories according to their frequency and amount of use during specific periods in the life-course. Latent class analysis (LCA) is a type of person-oriented approach that provides an appropriate method to classify individuals into distinct categories based on their similarity of responses across a range of variables. Its extension, latent transition analysis (LTA), enables researchers to study the longitudinal movements between these distinct latent classes. Given that peer selection and influence processes are theoretically understood to operate differently in different groups in predicting

adolescent drinking, it is useful to apply person-oriented analytic techniques to understand how peer mechanisms operate to affect the development of adolescent alcohol use. A more detailed technical introduction of LCA and LTA is presented in Chapter 2.

The next section presents a published systematic literature review of prospective studies that have examined the effect of peer mechanisms on the development of alcohol use among adolescents. The literature review was conducted as part of the thesis and was published online on June 8, 2011 in *Health Psychology Review* (Leung, Toumbourou, & Hemphill, 2011). The literature review includes a discussion that presents a Peer Process Model (PPM), developed based on the findings of the review of prospective studies. The PPM is proposed as a theoretical model to guide future research on the operation of peer process at different stages of adolescence that affect alcohol use behaviour.

1.1 Systemic literature review of longitudinal studies

The majority of individuals in developed western nations typically start using alcohol or other substances at some point during adolescence or early adulthood (Oxford, Harachi, Catalano, & Abbott, 2001). Similar to adults, drinking is primarily a social phenomenon for adolescents. Thus alcohol appears to be less stigmatised in comparison with tobacco and illicit drugs and is the most common substance used by adolescents (Wu & Ringwalt, 2006). While it is common for young people to start experimenting with alcohol during adolescence, early alcohol initiation is associated with alcohol-related problems later in life. The prevalence of lifetime alcohol dependence was 40.6% for those aged 12 years or younger at first use, compared to 16.6% and 10.6% for those initiating at 18 years and at 21 years respectively (Kokotailo et al., 2010). Although underage drinking and purchasing of alcohol is illegal, young people continue to report high

rates for accessibility and use of alcohol (Johnston, Bachman, & Schulenberg, 2007). Adolescent alcohol use remains a major public health concern that has serious consequences at both an individual and a societal level. Some of the alcohol-related problems associated with adolescent alcohol misuse include drink-driving, suicide, violence and sexual assault, and high-risk sexual behaviour (Brown et al., 2008; Kokotailo et al., 2010). Drinking is especially risky for adolescents because relative to adults, they are psychologically less equipped to drink responsibly (Crosnoe, Muller, & Frank, 2004). Young people are also vulnerable to alcohol-induced brain damage that could contribute to learning impairment and poor performance at school or work (NIAAA, 2003; White & Swartzwelder, 2004). Alcohol use disorders are the most prevalent psychiatric disorders among adolescents (Wu & Ringwalt, 2006). Some researchers view alcohol as a "gateway" drug that could lead to an increase in other illegal substance use (e.g., Kandel & Jessor, 2002; Welte & Barnes, 1985). For instance, the social context of underage alcohol use may place teenagers in a situation where other drugs are available and may increase chances of other substance uptake. Alcohol-related health problems pose a large burden on the health care system by increasing demand for mental health services and alcohol and drug treatment. Adolescent alcohol use also contributes to social costs in areas such as injuries, motor vehicle crashes, crime, violence, unprotected sexual intercourse, and by increasing educational failure that undermines economic contributions later in life (Hawkins, Catalano, & Miller, 1992).

A wealth of studies has been conducted to identify empirical predictors for adolescent alcohol use. It is evident that biological and psychosocial factors at multiple levels in different social domains such as in the family, school, peer group, and community all contribute to the development of alcohol and other drug use (Catalano, Kosterman, Hawkins, Newcomb, & Abbott, 1996). Peer factors in particular, have been identified as one of the most important risk factors for the use of legal and illegal substances by adolescents (Kandel, 1996). Relationships with peers are important in psychosocial development throughout childhood and adolescence. As children transition from family-centred development, friendships

take on unique significance providing companionship, social and emotional support, intimate self-disclosure and reflection for young people (Goldstein, Davis-Kean, & Eccles, 2005). During the adolescent pubertal transition, young people experience potentially stressful biological transitions over a relatively short period of time (including appearance, height and sex organ changes) and these physical changes are coupled with shifting personal expectations and new social demands which increase vulnerability to peer influence (Maxwell, 2002). This developmental period is also a time of trying new experiences and activities that emphasise socialising with peers and conforming to peer-group standards. Association with substance-using peers is considered to be one of the most salient and consistent predictors of adolescent substance use (Hawkins et al., 1992). Numerous studies have demonstrated that affiliation with alcohol-using peers increases the risk of adolescents' own use of alcohol (e.g., Dick et al., 2007; Ennett et al., 2008; Guilamo-Ramos, Turrisi, Jaccard, Wood, & Gonzalez, 2004).

Peer influence is widely accepted as a major causal element in the development of adolescent adjustment problems. Peer influence is defined as social processes with peers that lead to changes in adolescent attitudes and behaviours (Arnett, 2007). An important process of peer influence involves adolescents adjusting their beliefs, attitudes, and behaviours to conform to that of their friends (Kandel, 1996). Adolescents may be influenced by active persuasion to engage in a behaviour or indirectly by their perception of group norms, social acceptance, and status associated with the behaviour (Simons-Morton & Chen, 2006). Dishion and colleagues (1996) have described "deviancy training" processes in which communication and interactions within dyads of deviant adolescents reinforce changes toward antisocial behaviours. When an individual exhibits or talks about antisocial behaviour, other peers respond by positively reinforcing gestures and remarks. This in turn reinforces a young person who observes this norm and engages in similar talk or behaviour. Subsequently the observer becomes more deviant and is drawn into the peer culture (Dodge, Dishion, & Lansford, 2006).

In contrast, peer selection is defined on the basis of adolescents seeking out peers that are more closely matched to their own behaviours and attitudes. In the case of alcohol use, adolescents who use alcohol seek out peers with similar behaviour. Peer selection processes are partly explained by social identity theory that holds that "ingroup versus outgroup" judgments are a fundamental component in psychosocial identity development and groups that people belong to are an important source of pride and self-esteem (Tajfel & Turner, 1986). Identity issues become important to children age 10 to 15 years as they become more aware of societal and normative influences with increased experience with physical settings outside of the home. As early adolescents strive to identify where they belong within social groups and social categories (such as ethnicity and religion), it is likely that they will encounter decisions including whether to start using alcohol (Windle et al., 2008). Further, social cognition theories hold that the complexity challenge of communication and social interaction is reduced where friends are selected that share languages, tastes, and preferences.

Selection and influence processes are difficult to disentangle over time as adolescents and their friends become more similar as a result of continued association, interaction and influence. Exactly which, peer influence or selection, plays a more important role in adolescent alcohol use has been inadequately studied. There has been inadequate attention given to the important distinction between peer-influence (where the transition into alcohol use is preceded by exposure to alcohol-using friends) versus peer-selection (where alcohol use occurs initially in the absence of alcohol-using friends and is then followed by a transition into alcohol-using friendship group) processes. Numerous studies have shown that there is a positive relationship between adolescent and peer alcohol use in both cross-sectional and longitudinal studies. However, only longitudinal studies are capable of examining the effect of peer influence and selection separately. Further, there is little understanding as to how peer influence and selection processes operate to increase adolescent alcohol use. Other than viewing them as separate mechanisms, it is possible for the two to operate bi-directionally (Simons-Morton, 2007; Wills & Cleary, 1999). For instance, the

two processes can work together and maintain a setting of negative mutual peer processes in which alcohol-using adolescents select similar peers, their aggregation creating normative expectations that influence the development of adolescent alcohol use. It is important to understand the nature of peer processes operating between peer alcohol use and adolescent use so that an appropriate point of focus can be identified for prevention programs.

Although the physical and emotional changes associated with adolescent pubertal development occur over a considerable age range, pubertal onset typically begins by age 9 to 12 years and these physical changes are often completed by the middle of the teenage years (Dahl, 2004). The pubertal transition from childhood to adolescence introduces sexual motives that unsettle the family social relationships of childhood by increasing focus on peer association and acceptance (Windle et al., 2008). Children begin to invest in peers as their primary source of social and emotional support as they enter early adolescence (Heilbron & Prinstein, 2008). With the greater emphasis on peer relations during puberty, adolescents become more likely to internalise the views of their peers, to seek peer approval and be subject to peer influence. Patton and colleagues (2004) demonstrated that pubertal staging was strongly associated with adolescent substance use and that associations with substance-using friends differed across pubertal stages, with an increasing number of friends being substance users in late puberty. It was also found that peer substance use mediated the effect of puberty on alcohol use.

Early pubertal timing among boys and girls is one of a number of factors that has been associated with early initiation and increased levels of adolescent alcohol use (Biehl, Natsuaki, & Ge, 2007; Westling, Andrews, Hampson, & Peterson, 2008). Early maturing adolescents may be subjected to different peer processes due to peer rejection from normative groups for violating age-appropriate physical appearance conventions (Engels, 2009) and in turn they seek out older peers who may have already tried alcohol (peer selection). Transitions

to high school where older peers are available provide opportunities for early maturers to select themselves into older peer groups.

In addition to pubertal timing, a range of influences have been shown to predict early age involvement in alcohol use and peer selection. Amongst these are family risk factors such as low parental monitoring or lax supervision, family history of drug use, crime, or psychiatric problems and childhood risk factors such as hyperactivity, impulsiveness and behaviour disorders, with the cumulative number of early age risk factors predicting a greater likelihood of early age involvement in alcohol and drug use (Toumbourou & Catalano, 2005). Early maturers are more likely to start using alcohol at a young age where they have high levels of other risk factors (Costello, Sung, Worthman, & Angold, 2007). Early age alcohol users may have different motives for substance use (e.g., to escape distressing experiences - Toumbourou et al., 2007), tend to initiate alcohol use at a stage in their development when same-age peers are not involved in this behaviour and hence, are less likely to be influenced by same-age peers. Although alcohol users are not prevalent in late childhood, this behaviour is predictive of the development of co-morbid and severe alcohol-related disorders by late adolescence (~ 16 to 20 years of age; Brown et al., 2008; Toumbourou & Catalano, 2005).

Since alcohol use is common in our society, as they get older a greater percentage of post-pubertal adolescents have peers that initiate alcohol use. For example, a national survey in the US found that 76% of 8th graders and 92% of 10th graders reported having friends who use alcohol (Marshal & Chassin, 2000). As peer alcohol use becomes more prevalent among older adolescents so too peer pressure increases to conform and start drinking. Although it is possible to speculate that peer selection and peer influence effects may operate sequentially across adolescent development, to date there has been no systematic review of available longitudinal studies that has attempted to synthesise peer process findings.

The aim of the present review is to investigate the longitudinal relationship between peer influence and adolescent alcohol use. In particular, the review aims to examine evidence for the effect of peer influence relative to selection in the development of adolescent alcohol use and to identify factors that moderate and/or mediate peer influence. The review sought to develop a model of peer processes relevant to different stages of the development of adolescent alcohol use.

1.1.1 Method

1.1.1.1 Search strategy and selection criteria

This review focused on research that has examined the prospective association between peer drinking behaviour and adolescents' own use of alcohol. Articles were identified from the following computerised databases: PsycINFO, MEDLINE, Social Science Citation Index (SSCI), Education Resources Information Center (ERIC), and Sociological Abstracts. The searches were restricted to publications written in English between January 1997 and February 2011. The comprehensive review by Tobler and Stratton (1997) suggested that peers were an important influence on adolescent substance use. As a number of longitudinal studies have been reported since that review, we sought to include longitudinal studies published over the last fourteen years. To include as many articles as possible search terms with similar meaning that describe peer exposure were used (e.g., peer group, peer influence, or peer selection). Association with antisocial or deviant peers were also used as search terms because it has been shown that affiliation with deviant peers also predicts adolescent substance use (Hawkins et al., 1992). Reference lists of all included articles were also manually searched for potentially eligible studies. No attempt was made to include unpublished studies or conference abstracts by contacting key investigators. A total of 309 article abstracts were obtained from the searches.

1.1.1.2 Inclusion criteria

The inclusion criteria used to select articles from the abstracts were the following: (a) the independent predictor included adolescent alcohol use and/or peer variables such as peer drinking/alcohol use or deviant peer affiliation, (b) adolescents' own use of alcohol or drinking behaviours and/or peer variables were the outcomes of interest, (c) the target population included children and adolescents aged up to 18 years, (d) the sample size of a study was large enough to measure moderate effects (the smallest included study had 188 individuals, (e) the study had two or more waves of prospective longitudinal data and were analysed by a quantitative method, and (f) a main effect of peer factors on adolescent alcohol use was tested.

Screening and selection of studies were undertaken by two authors by reading the titles and abstracts of the articles to determine which articles should be included. The number of included articles was 56 and the hard copies of these studies were retrieved. Thirty-four of the retrieved articles were excluded after initial reading because they did not meet the inclusion criteria. The total number of articles included in the final analysis was 22. Meta-analysis was not performed as the studies identified used divergent approaches in their methods and analyses. Data extraction and narrative synthesis were undertaken by the lead author with all details checked by co-authors.

1.1.1.3 Quality assessment

As recommended by the Cochrane Non-Randomized Studies Methods Working Group, the quality of the included studies was evaluated by the validated Newcastle-Ottawa Scale (NOS; Wells et al., 2008). The instrument was developed to assess the quality of nonrandomised studies including observational studies. The NOS uses a "star" rating system to judge quality based on three broad areas: the selection of the study groups, the comparability of the groups, and the ascertainment of the outcome of interest. The maximum number of stars a

study may receive in each of these categories is four, two, and three respectively. The validity of the NOS rating scale has been previously demonstrated. NOS ratings of the included articles were completed by the first author and ratings of randomly selected articles were cross-checked by a co-author. Any discrepancies in the ratings were discussed to reach consensus and ratings were then revised based on the discussion when necessary.

1.1.2 Results

Table 1.1 presents a summary of study populations, designs, and quality scores of the 22 studies that met the inclusion criteria. Because all included studies used self-report measures for exposure to peer influence and drinking outcomes, a quality score from the category "selection" and "outcome" of the NOS was not awarded for self-report measures. Therefore, the highest possible number of stars for the included studies was seven out of nine stars for quality assessment. Fifteen studies were judged to have good research quality with seven stars and seven studies received six stars.

Most of the studies were conducted with US samples of adolescents except four were based on adolescents from the Netherlands, one reported on young people from New Zealand, and one was based on adolescents from Germany. Twelve studies collected data from students when they were in school, four studies used data from national youth surveys, three studies collected data from selected adolescent samples in which on average 45% of them had problem-drinking fathers/parents (participants from two studies were interviewed at home and the other study used data from an ongoing longitudinal study), and in three studies participants filled in questionnaires in their own home in the presence of a trained interviewer. The time interval between follow-ups varied from 6 months to 4 years depending on the study design. The number of longitudinal study observation points ranged from two to five. Attrition rates ranged from 1% to 33% among 14 studies; eight studies did not report their attrition rates.

Table 1.1
Summary of reviewed studies' population, design, and quality score.

Study (country)	Participants	Length of follow up	Attrition rates	Quality score
1. Bot et al., 2005 (The Netherlands)	1,251 (analytic sample) followed-up from 1,589 adolescents aged from 10 to 14 years (M=12.3)	2 assessments in Nov/Dec, 2000 and in May/Jun, 2001 (~ 6 to 7 months); surveys completed in school	Not reported	NOS* = 7/9 (selection 3/4, comparability 2/2, outcome 2/3)
2. Bray et al., 2003 (US)	6,048 7th, 8th, & 9th grader; 40% were non-Hispanic Whites, 35% Mexican American, and 25% African American	3 annual assessments; surveys completed in school	11.2% in the 2nd year; 19.8% in the 3rd year	NOS = 6/9 (selection 3/4, comparability 1/2, outcome 2/3)
3. Crawford and Novak, 2002; the National Education Longitudinal Survey (US)	18,116 Grade 10 students at T1; exact age not reported	1 assessment 2 years later; secondary analysis using national survey	Not reported	NOS = 6/9 (selection 3/4, comparability 2/2, outcome 1/3)
4. Curran, Stice, & Chassin, 1997 (US)	454 adolescents (M=12.7 years) at T1 (246 and 208 adolescents with and without alcoholic parent respectively); final sample was 363 adolescents with mean age of 12.9 at T1	3 assessments over 3 years; surveys completed at home	1% at T2 and 2% at T3; 74 adolescents who reported no self or peer substance use at any of the 3 time waves were dropped	NOS = 7/9 (selection 3/4, comparability 2/2, outcome 2/3)

Table 1.1 (continued)

Study (country)	Participants	Length of follow up	Attrition rates	Quality score
5. D'Amico & McCarthy, 2006 (US)	974 students aged from 10 to 15 years (M=12) at T1	2 assessments in Nov and May of a single school year (~7 months); surveys completed in school	Not reported	NOS = 7/9 (selection 3/4, comparability 2/2, outcome 2/3)
6. Engels et al., 1999 (The Netherlands)	1,063 of 1,454 secondary school students with mean age of 12.4 years	3 waves over 5 years; 2 years between T1 and T2; 3 years between T2 and T3; surveys completed in school	18% at both T2 and T3	NOS = 6/9 (selection 3/4, comparability 1/2, outcome 2/3)
7. Fergusson, Swain-Campbell, & Horwood, 2002; the Christchurch Health and Development Study (New Zealand)	1,063 of 1,265 young people who were 14 years old at T1 and were followed up to the age of 21	Annual assessments from age 14 to 16; again at ages 18 and 21; secondary analysis using data from a national survey	23.7% at age 15; 24.7% at age 16; 19.0% at age 18; 20.1% at age 21 (number of observations varied each year)	NOS = 7/9 (selection 3/4, comparability 2/2, outcome 2/3)
8. Jaccard, Blanton, & Dodge, 2005; the Add Health database (US)	1,692 students from Grade 7 to 12; exact age was not reported	2 annual assessments; surveys completed in school	20%	NOS = 7/9 (selection 3/4, comparability 2/2, outcome 2/3)

Table 1.1 (continued)

Study (country)	Participants	Length of follow up	Attrition rates	Quality score
9. Li et al., 2002; the National Youth Survey (US)	188 of 1,725 participants aged 14 year old at T1 and were followed up to 18 years of age	5 annual assessments; secondary analysis using data from a national survey	Not reported	NOS = 7/9 (selection 3/4, comparability 2/2, outcome 2/3)
10. Marshal & Chassin, 2000 (US)	300 of 454 adolescents with a mean age of 12.7 years at T1; 48% of them had an alcoholic father	2 waves of data; follow-up period not reported; secondary analysis using a subsample of an ongoing longitudinal study	Not reported	NOS = 6/9 (selection 3/4, comparability 2/2, outcome 1/3)
11. Maxwell, 2002; the National Longitudinal Study of Adolescent Health (US)	1,969 of 3,702 adolescents aged 12 to 18 years old	2 annual assessments; secondary analysis using data from a national survey	26.3% at T2	NOS = 7/9 (selection 3/4, comparability 2/2, outcome 2/3)
12. Poelen, et al., 2007; the "Family and Health" longitudinal study (The Netherlands)	428 siblings dyads at T1; mean age of younger siblings was 13.4 (range 13-15 years) and that of older siblings was 15.2 (range 14-17 years)	2 annual assessments; surveys were completed at home	3%	NOS = 6/9 (selection 3/4, comparability 1/2, outcome 2/3)

Table 1.1 (continued)

Study (country)	Participants	Length of follow up	Attrition rates	Quality score
13. Reifman et al., 1998 (US)	699 adolescents aged from 13 to 16 years at wave 1; 31.5% had problem-drinking fathers	3 annual assessments; surveys completed at home	5.9% at T2 and 12.4% at T3; 112 regular drinkers at T1 were excluded from further study	NOS = 7/9 (selection 3/4, comparability 2/2, outcome 2/3)
14. Schulenberg et al., 1999; the Alcohol Misuse Prevention Study (US)	1,297 (21% of total sample) of 6th graders from the control groups; 478 and 819 adolescents from cohort 1 in 1985 and cohort 2 in 1990 respectively	3 annual assessments; surveys completed in school	31% and 33% for cohort 1 and 2, respectively, through 8th grade	NOS = 7/9 (selection 3/4, comparability 2/2, outcome 2/3)
15. Sieving, Perry, & Williams, 2000; Project Northland (US)	1,804 of 2,456 adolescents (full baseline sample) in 7th grade at T1 (863 and 941 adolescents from the reference and intervention condition respectively	3 annual assessments; surveys completed in school	Not reported	NOS = 6/9 (selection 3/4, comparability 1/2, outcome 2/3)
16. Simons-Morton, 2004 (US)	910 of 1,490 6th graders with 75% of them were age 11 at T1	2 assessments at the beginning and the end of 6th grade (~9 months); surveys completed in school	15% at T2	NOS = 7/9 (selection 3/4, comparability 2/2, outcome 2/3)

Table 1.1 (continued)

Study (country)	Participants	Length of follow up	Attrition rates	Quality score
17. Simons-Morton, 2007 (US)	2,453 of 2,969 students assessed in 6th grade	5 waves over 4 years; surveys completed in school	Not reported	NOS = 7/9 (selection 3/4, comparability 2/2, outcome 2/3)
18. Stice, Myers, & Brown, 1998 (US)	390 high school students aged from 16 to 19 years at T1	2 assessments in fall and again in spring (~7 months); surveys completed in school	28.8% at T2	NOS = 6/9 (selection 3/4, comparability 1/2, outcome 2/3)
19. Van Der Vorst et al., 2009 (The Netherlands)	401 families with 2 parents and 2 biological adolescent children; mean age of the younger siblings was 13.4 years and that of the older siblings was 15.2 years	3 annual assessments; surveys completed at home	3% at T2; 6% at T3	NOS = 7/9 (selection 3/4, comparability 2/2, outcome 2/3)
20. Urberg, Değirmencioğlu, & Pilgrim, 1997 (US)	477 and 551 adolescents in grades 6, 8 and 10 in school system 1 (77% African American) and 2 (92% White) respectively	Assessments in October and May of a single school year (~7 months) ; surveys completed in school	8.9% at T2	NOS = 7/9 (selection 3/4, comparability 2/2, outcome 2/3)

Table 1.1 (continued)

Study (country)	Participants	Length of follow up	Attrition rates	Quality score
21. Urberg et al., 2003 (US)	81% of 477 and 551 adolescents in system 1 and 2 respectively	4 waves of data over 3 years; surveys completed in school	8.9% at T2; 18.6% at T4	NOS = 7/9 (selection 3/4, comparability 2/2, outcome 2/3)
22. Wiesner, Silbereisen, & Weichold, 2008; the Leipzig Schüler-Intervall Study (Germany)	1,619 adolescents with mean age of 14.1 years at Wave 6 and were followed up to the age of 18	Waves 6 to 9 from 1991 to 1995; secondary analysis using data from a national survey	Not reported	NOS = 7/9 (selection 3/4, comparability 2/2, outcome 2/3)

*NOS = Newcastle-Ottawa Scale

A summary of measures of peer predictors and outcomes, analytic methods used, and relevant findings of the reviewed studies is presented in Table 1.2. Measures for the exposure of peer influence varied among studies. Three main types of peer influence measures were used: eleven studies used perceived peer alcohol use, six studies used perceived deviant or unconventional peer group behaviours and five studies used social network designs to record close friends' own report of drinking behaviour. For measures of perceived peer alcohol use, respondents were asked to report the number of their friends who used alcohol and/or other drugs or to report the frequency and quantity of alcohol use by their best friends. For measures of the association with deviant peers, respondents were asked if they belonged to a peer group that engaged in deviant or antisocial behaviours, or to report the number of their friends who engaged in antisocial behaviour such as being suspended from school, breaking the law, and/or substance use. With social network study designs, it is possible to obtain close friends' own report of drinking behaviour by asking respondents to nominate their close friend's name and match their data within the study sample.

The outcome measures of adolescents' own drinking behaviour also varied among studies. While most studies (15) asked respondents to report the frequency of using alcohol during the past 30 days or 12 months, four studies asked adolescents to report the number of alcoholic drinks they had 7 days or 30 days prior to the interview, two studies asked for the number of days respondents had used alcohol in the past 30 days or had engaged in binge drinking (5 or more drinks in a row) in the past 12 months, and one study asked respondents whether they got sick and became very drunk in the past 12 months. Moreover, studies have different approaches for analysing and reporting the outcome measures. In particular, three studies examined drinking initiation, two studies reported alcohol dependence and related-harm and over-indulgence among adolescents, one study investigated both the escalation and de-escalation of alcohol use, and one study examined the transition of becoming a regular or heavy episodic drinker.

Table 1.2
Summary of measures for peer factors and outcomes, analytic methods and major findings.

Study (country)	Peer predictor	Outcome	Methodology	Relevant findings & comments
1. Bot et al., 2005 (The Netherlands)	Best friends' own report of drinking behaviour (quantity of alcohol use)	Respondents' drinking behaviour at T2, 6 months later (quantity of alcohol use in the past 7 days)	Hierarchical regression analyses adjusted for baseline drinking, sociometric variables, gender, and age	- best friends' drinking behaviour at T1 predicted respondents' drinking at T2 (influence), after adjustment for other factors - respondents' and friends' drinking behaviour at T1 was controlled in the analyses hence peer selection effect was controlled
2. Bray et al., 2003 (US)	Student-reported peer alcohol use (number of friends and peers using alcohol)	Adolescent frequency of alcohol use in the past 30 days and 12 months	Latent growth modelling	- respondents with more alcohol-using peers at baseline showed higher rates of baseline alcohol use (selection) and hence a lower rate of increase in alcohol use over time - provided support for the bidirectional and mutual influence of peer and adolescent alcohol use over time and was consistent across ethnic groups; however, the mechanism of bidirectional influence was not clear
3. Crawford and Novak, 2002; the National Education Longitudinal Survey (US)	Affiliation with unconventional peers; unstructured peer interaction	Adolescent frequency of lifetime alcohol use and binge drinking in the past 2 weeks	Ordinary Least Squares (OLS) regression; adjusted for gender, race, and SES status	- unconventional peer affiliation was significantly associated with life time alcohol use and binge drinking at T2 (influence) - unstructured peer interaction was found to be a better predictor of life time alcohol use at T2 and also a significant predictor of students who became drinkers or binge drinkers at T2 - controlled for respondents' alcohol use in T1 hence peer selection effect was controlled

Table 1.2 (continued)

Study (country)	Peer predictor	Outcome	Methodology	Relevant findings & comments
4. Curran, Stice, & Chassin, 1997 (US)	Student-reported peer use of alcohol (number of friends who drank occasionally and regularly)	Adolescent and peer frequency of alcohol use and binge drinking in the past 12 months (follow-up period not clear)	Latent growth modelling	- respondents with more alcohol-using peers at baseline showed a higher rate of increase in alcohol use over time (influence) - earlier adolescent use was associated with changes in peer use and earlier peer use was related to changes in adolescent use, which shows bi-directional effects - prospective bi-directional relationship between peer alcohol use and adolescent use remained even after inclusion of rebelliousness - provided support for both peer selection and peer socialization/influence but unable to illuminate the underlying mechanisms
5. D'Amico & McCarthy, 2006 (US)	Perceived peer alcohol and marijuana use (number of friends used alcohol and marijuana)	Frequency of personal lifetime and past 30-day alcohol use at T2	Hierarchical regression analyses adjusted for race, gender, grade, baseline personal use and perceived peer use	- perceived peer alcohol and marijuana use at T1 was associated with increased personal alcohol at T2 (influence) - perceived peer alcohol use predicted onset of personal use of alcohol (influence) - respondents' drinking behaviour and peer substance use at T1 was controlled in the analyses hence peer selection effect was controlled

Table 1.2 (continued)

Study (country)	Peer predictor	Outcome	Methodology	Relevant findings & comments
6. Engels et al., 1999 (The Netherlands)	Student-reported drinking status of 2 closest friends	Frequency of adolescent alcohol use in their lifetime, past 6 months and past 4 weeks (2 & 3 years later)	Structural equation modelling	- Age 12 (T1) perceived best friends' use significantly predicted age 14 (T2) adolescent frequent use (influence), while ages 12 and 14 adolescent frequent use predicted age 14 and 17 friends' use (selection) - Peer selection was independently influenced by parent alcohol use
7. Fergusson, Swain-Campbell, & Horwood, 2002; the Christchurch Health and Development Study (New Zealand)	Deviant peer affiliation (includes friends using substances or engaging in antisocial behaviour)	Adolescent alcohol abuse/ dependence (alcohol related problems)	Fixed effect logistic regression model adjusted for confounding by fixed factors, age, measures of exposure to life events, age of school and home leaving, and exposure to unemployment	- respondents with high levels of deviant peer affiliations were found to have elevated rates of alcohol abuse/dependence - those aged 14 to 15 show the greatest susceptibility to affiliation with deviant peers - the association between deviant peer affiliation and substance problems was reduced quite substantially after controlling for confounding factors suggesting the presence of selection processes - results also suggested the presence of peer influence

Table 1.2 (continued)

Study (country)	Peer predictor	Outcome	Methodology	Relevant findings & comments
8. Jaccard, Blanton, & Dodge, 2005; the Add Health database (US)	One nominated same-sex friend's own report of binge drinking (number of days of binge drinking in the past 12 months)	Adolescent frequency of binge drinking (number of days of binge drinking in the past 12 months; change from T1 to T2)	Generalised estimating equations (GEE); controlled for concomitant changes in the quality of relationship with mother, physical development, parental control, and romantic relationship across time	- 1 unit change on peer binge drinking scale across time is associated with 0.12-unit change on adolescent binge drinking scale (95% CI = 0.10 to 0.14, $p<.05$). It is unclear whether the association reflect peer influence - controlled for friendship selection effects by controlling previous binge drinking histories of peer and adolescents

Table 1.2 (continued)

Study (country)	Peer predictor	Outcome	Methodology	Relevant findings & comments
9. Li et al., 2002; the National Youth Survey (US)	Exposure to deviant peer (number of friends engaged in substance use or antisocial behaviour)	Adolescent frequency of alcohol use	Latent variable growth mixture modelling	- A two-class model identified two trajectory classes: "low-average users group" and "high-average users group" which reported a low- and high- average levels, respectively, of alcohol use at age 16 - the magnitude of the significant lagged peer effects on adolescent alcohol use increased with each successive year from age 15 onwards for the low-average users group (influence) - for the high-average users group, the magnitude of significant lagged peer effects decreased each year after age 15 and peer exposure at age 17 was not predictive of age 18 alcohol use, partly explained by stable high levels of alcohol use and involvement with alcohol-using peers in this group - levels of exposure to deviant peers was significantly related to the levels of adolescent alcohol use and to the rate of change in alcohol use over time for low-average users group - provided some evidence supporting both the peer influence and selection model in the low-average users group but not for the high-average users group

Table 1.2 (continued)

Study (country)	Peer predictor	Outcome	Methodology	Relevant findings & comments
10. Marshal & Chassin, 2000 (US)	Drug-using peer affiliation (student-reported number of friends who used and approved of substance use)	Adolescent quantity (number of glasses) and frequency of alcohol use in the past 12 months at T2	Hierarchical regression analyses adjusted for baseline alcohol use, age, gender, paternal alcohol use, peer drug use, and parent social support	-Drug-using peers predicted alcohol use (influence) after adjusting for other factors - respondents' drinking behaviour and peer drug use at T1 was controlled in the analyses hence peer selection effect was controlled
11. Maxwell, 2002; the National Longitudinal Study of Adolescent Health (US)	One random same sex friend's own report of frequency of alcohol use	Adolescent alcohol use at T2, 1 year later (number of days of alcohol use in the past month)	Hierarchical regression analyses, adjusted for baseline use, race, gender, and friend's use	- respondents were found to be 58% more likely to use alcohol at T2 if a random same sex friend also used alcohol at T1 (influence) - respondents' and friends' drinking behaviour at T1 was controlled in the analyses hence peer selection effect was controlled
12. Poelen et al., 2007; the "Family and Health" longitudinal study (The Netherlands)	Perceived best friends' frequency and amount of alcohol use	Adolescents' self-reported frequency in the past 4 weeks and number of alcoholic beverages	Structural equation modelling	- prospective association between best friends' drinking and adolescent's drinking was found for the younger sibling, but the magnitude of effect was small (β=.15, $p<.05$) - friends' drinking at T1 appeared to predict initiation of older siblings' drinking at T2 (influence) - showed consistent support for selective peer affiliation in that evidence was found from the path from adolescents' drinking at T1 to friends' drinking at T2 (selection)

Table 1.2 (continued)

Study (country)	Peer predictor	Outcome	Methodology	Relevant findings & comments
13. Reifman et al., 1998 (US)	Perceived closest friends' drinking behaviour (frequency and quantity of alcohol use)	Becoming a regular drinker or transition into heavy episodic drinking	Logistic regression analyses adjusted for age, gender, race, parental factors, peer factors, and baseline drinking	- friends' drinking behaviour (influence) was found to be one of the two strongest predictors of advancing to heavier drinking (becoming a regular drinker) and across the 2 intervals (wave 1 to 2 and wave 2 to 3) - respondent's and friend's drinking behaviour at T1 was controlled in the analyses hence peer selection effect was controlled
14. Schulenberg et al., 1999; the Alcohol Misuse Prevention Study (US)	Exposure to peer alcohol use (student reported number of friends who used alcohol and were in trouble because of drinking)	Alcohol over-indulgence (drank more than planned, got sick, and very drunk) in 7th and 8th grade	Structural equation modelling	- peer exposure at 6th grade predicted increased over-indulgence (influence) and over-indulgence predicted exposure (selection) one year later for students in high- and medium-susceptibility groups - Influence and selection were also evident in predicting to 8th grade, but only for medium susceptible groups

Table 1.2 (continued)

Study (country)	Peer predictor	Outcome	Methodology	Relevant findings & comments
15. Sieving, Perry, & Williams, 2000; Project Northland (US)	Perceived best friends' use of cigarette and alcohol; perceived peer alcohol and drug use/offer	Adolescents' frequency of alcohol misuse in the past month, past year, and lifetime	Structural equation modelling	- there were significantly fewer students in the intervention sample that reported alcohol use than students in the reference condition (Komro et al., 2001) - peer alcohol and drug use/offers at T1 and T2 had significant, direct effects on adolescent's alcohol use at T2 and T3 (influence) - friends' drug use had an equivalent impact on adolescents' alcohol use within intervention and reference samples - peer selection effects were only evident in the intervention sample but not in the reference sample
16. Simons-Morton, 2004 (US)	Association with antisocial peer (student-reported number of close friends engaged in antisocial behaviours)	Initiation of past 30 days drinking (frequency of alcohol use)	Hierarchical logistic regression analyses adjusted for race and sex	- association with antisocial peers was found to independently predict initiation of recent drinking (influence) - excluded baseline drinkers, hence did not examine selection
17. Simons-Morton, 2007 (US)	Substance using friends (student-reported number of close friends who smoked and drank)	Adolescent frequent drinking behaviour in the past 30 days and past 12 months in 7th, 8th & 9th grades	Latent growth curve analysis	- growth in substance-using friends increased the likelihood of growth in adolescent alcohol use and vice versa - results suggested reciprocal influence; provided support for both peer influence and selection

Table 1.2 (continued)

Study (country)	Peer predictor	Outcome	Methodology	Relevant findings & comments
18. Stice, Myers, & Brown, 1998 (US)	Perceived peer alcohol use (number of friends used alcohol)	Alcohol escalation and de-escalation at T2 (9 months later)	MANOVA & ANOVA	- greater peer alcohol use predicted increased adolescent alcohol use (escalation from abstinence to moderate alcohol use) (influence) - less peer alcohol use at T1 was marginally associated with de-escalation from heavy alcohol use to moderate use

Table 1.2 (continued)

Study (country)	Peer predictor	Outcome	Methodology	Relevant findings & comments
19. Van Der Vorst et al., 2009 (The Netherlands)	Perceived best friends' frequency and amount of alcohol use	Adolescents' self-reported frequency in the past 4 weeks and number of alcoholic beverages	Latent class growth analysis & multinomial logistic regression adjusted for age, gender, parental alcohol use and alcohol-specific rules (used by parents)	- four different drinking trajectories were found for early adolescents (13-year-olds at T1): abstainers, light drinkers, increasers (strongly increased their drinking over time), and heavy drinkers (drank heavily at T1 and increased drinking strongly within 2 years) - a fifth trajectory, stable drinkers (drank 6 glasses of alcohol per week at all 3 time points), was found for mid-adolescents in additional to the same four trajectories identified for early adolescents - for early adolescents, increasers (OR=1.17; $p<.05$) or heavy drinkers (OR=1.31; $p<.01$) were more likely to have heavy drinking friends than abstainers - for mid-adolescents, best friends of increasers (OR=1.16; $p<.001$), stable drinkers (OR=1.31; $p<.001$), and heavy drinkers (OR=1.21; $p<.001$) were more likely to drink than the best friends of light drinkers - results suggested that best friends' alcohol consumption becomes important after initiation of drinking. However, whether these results were due to influence or selection processes is not known

Table 1.2 (continued)

Study (country)	Peer predictor	Outcome	Methodology	Relevant findings & comments
20. Urberg, Değirmencioğlu, & Pilgrim, 1997 (US)	Friendship groups and close friends' own report of frequency of alcohol use	Adolescents' initiation and transition-in-to-current use of alcohol	Hierarchical logistic regression analyses adjusted for grade, gender, and ethnicity in initiation of use	- close friends' alcohol use predicted transition into respondents' current alcohol use - both friendship groups' and close friends' use of alcohol independently predicted transition into alcohol intoxication - only examined drinking initiation hence reported effect of peer influence - the effect size of peer influence is distinctly moderate suggesting that selection may account for much of the similarity in substance use between adolescents and their friends
21. Urberg et al., 2003 (US)	Friends' own report of frequency of alcohol use, positive friendship quality at T3	Adolescent frequency (lifetime and gotten drunk in the past month) and quantity of alcohol use in the past month from T3 to T4 (follow up period unclear)	Hierarchical regression analyses, adjusted for baseline own substance use, grade, sensation seeking, friend qualities and conflict	- respondents' alcohol use was predicted by alcohol use of friends who were from relationships with medium or high levels of positive quality and low conflict in friendship (influence) - respondents' drinking behaviour at T1 was controlled in the analyses hence peer selection effect was controlled

Table 1.2 (continued)

Study (country)	Peer predictor	Outcome	Methodology	Relevant findings & comments
22. Wiesner, Silbereisen, & Weichold, 2008; the Leipzig Schüler-Intervall Study (Germany)	Deviant peer association (student reported whether they belonged to a group that engaged in illegal activities)	Adolescent alcohol use (quantity of use; number of glasses of beer, wine, and hard liquor)	Latent growth mixture modelling	- consistent concurrent effect of deviant peer association was found on regular users group which reflect a mixture of both selection and influence processes - very few significant lagged effects of deviant peers association was observed; generally non-significant

Note. T1 = Time 1 (baseline), T2 = Time 2, T3 = Time 3, T4 = Time 4.

There were ten studies that used regression analysis, six studies used latent growth models, four studies used structural equation models (SEM), one study used analysis of variance (ANOVA), and one study used generalised estimating equations (GEE). For regression analyses and GEE, peer influence effects could be separated from that of peer selection by investigating only the initiation of drinking behaviour or by controlling for adolescents' previous drinking behaviour statistically (Urberg, Değirmencioğlu, & Pilgrim, 1997). Controlling for Time 1 (T1, baseline) alcohol use makes it possible to more confidently draw conclusions about the directionality of peer influence effects on adolescent alcohol use (Marshal & Chassin, 2000). Eleven studies reported effect sizes (odd ratios) that ranged between 1.06 (the risk of respondents' increased frequency of lifetime alcohol use at T2 (longitudinally measured outcome) associated with unconventional peer affiliation at T1; Crawford & Novak, 2002) and 4.86 (the risk of adolescent alcohol use at T2 associated with having random same-sex friend who drank at T1; Maxwell, 2002).

With the advances in statistical methods, latent growth models in particular, it is possible to analyse the over-time relationships of the slopes of the variables in parallel process analyses and to examine simultaneous change in both the predictor and the outcome (Simons-Morton, 2007). The key comparison in latent growth models is between the intercepts and the slopes. For example, such models can examine the effect of peer influence on the growth of alcohol use (slope) assuming the intercept controls for initial alcohol use (selection). SEM can investigate peer selection effects by including cross-lagged paths between alcohol-using peers and adolescents' own use in the analytic model.

All studies found alcohol-using peers or deviant peers to be predictive of adolescents' alcohol drinking behaviour at a later wave, except for the study done by Wiesner and colleagues (2008) that reported non-significant lagged effects of deviant peer association on alcohol use. Only one study reported a protective effect of peer alcohol use; that less peer alcohol use was marginally associated with de-escalation from heavy alcohol use to moderate use (Stice, Myers, &

Brown, 1998). As one method of controlling peer selection processes, eight studies used regression or GEE to control for adolescents' alcohol use at baseline (a necessary condition for selection) and therefore using this method to isolate the effect of peer influence on adolescent drinking behaviour. These studies found that exposure to peer alcohol use (influence) maintained a significant predictive effect after adjusting for prior alcohol use (selection) (Bot, Engels, Knibbe, & Meeus, 2005; Crawford & Novak, 2002; D'Amico & McCarthy, 2006; Jaccard, Blanton, & Dodge, 2005; Marshal & Chassin, 2000; Maxwell, 2002; Reifman, Barnes, Dintcheff, Farrell, & Uhteg, 1998; Urberg, Luo, Pilgrim, & Değirmencioğlu, 2003). Three regression studies also reported the effect of peer influence by examining drinking initiation and found that association with antisocial peers, unstructured peer interaction, or close friends' alcohol use independently predicted initiation of adolescents' drinking behaviour (Crawford & Novak, 2002; Simons-Morton, 2004; Urberg et al., 1997). Furthermore, in analyses that control for friends' alcohol use, adolescents' own use of alcohol is a variable representing a quasi-marker for peer selection. Six studies using regression analyses reported that adolescent alcohol use maintained a predictive effect for escalating patterns of use after controlling for peer alcohol use at baseline (influence) (Bot et al., 2005; D'Amico & McCarthy, 2006; Jaccard et al., 2005; Marshal & Chassin, 2000; Maxwell, 2002; Reifman et al., 1998). For studies using latent growth models or SEM, all provided evidence to support both peer influence and selection processes (Bray, Adams, Getz, & McQueen, 2003; Curran, Stice, & Chassin, 1997; Engels, Knibbe, De Vries, Drop, & Van Breukelen, 1999; Li, Barrera, Hops, & Fisher, 2002; Poelen, Engels, Van Der Vorst, Scholte, & Vermulst, 2007; Schulenberg et al., 1999; Sieving, Perry, & Williams, 2000; Simons-Morton, 2007; van der Vorst, Vermulst, Meeus, Deković, & Engels, 2009), except that Weisner and colleagues (2008) found concurrent effects of deviant peer association on alcohol use which did not provide evidence to support either peer influence or the selection processes.

Table 1.3 presents a list of the 15 moderators identified from nine of the reviewed studies. Age was found to have moderating effects on deviant peer association or friends' drinking behaviour with the effect of peer influence declining with increasing age (Engels et al., 1999; Fergusson, Swain-Campbell, & Horwood, 2002; Schulenberg et al., 1999). Schulenberg and colleagues (1999) conceptualised "susceptibility to peer pressure to misbehave", as an individual characteristic measurable using self-report items. The construct reflects the extent of susceptibility to general misbehaviour, such as whether respondents self reported they would skip school or try smoking when dared by their friends. The construct may be an indicator of risk factors at an early age. It was identified as a moderator in that peer exposure at Grade 6 predicted increased overindulgence (peer influence for heavy alcohol use) and overindulgence predicted exposure (selection) one year later for students in medium- and high-susceptibility groups.

Table 1.3

List of moderators identified and their corresponding reviewed study.

Study (country)	Moderators identified
1. Bot et al., 2005 (The Netherlands)	• Friendship stability (had the same best friend at Time 1 and Time 2) • Friendship reciprocity (the respondents' friends also named the respondents in their friends' list) • Friend's sociometric popularity status (calculated by subtracting the number of "least popular" from the number of "most popular" nominations received from their class peers)
2. Bray et al., 2003 (US)	• Intergenerational individuation (reflects a capacity to take responsibilities for the self without being controlled by dominating parents)

Table 1.3 (continued)

Study (country)	Moderators identified
3. Crawford and Novak, 2002; the National Education Longitudinal Survey (US)	• Gender • Parental attachment (an index of 6 items measuring the quality of child-parent relations) • Parental control (an index of 13 items measuring whether the respondents felt that their parents actually regulated their behaviours)
6. Engels et al., 1999 (The Netherlands)	• Age
7. Fergusson, Swain-Campbell, & Horwood, 2002; the Christchurch Health and Development Study (New Zealand)	• Age
8. Jaccard, Blanton, & Dodge, 2005; the Add Health database (US)	• Peer similarity in drinking behaviour (both the target individual and the peer engaged in drinking in the absence of parents or other adults in the family) • Satisfaction with maternal relationship (rated on a scale of 1 to 5; higher number indicate greater agreement)
10. Marshal & Chassin, 2000 (US)	• Gender • Parental support (parents self-reported; a composite of 6 items assessing the amount of social support provided to the child) • Parental discipline (parents self-reported; a composite of 5 items assessing the consistency of maternal and parental discipline to the child)
14. Schulenberg et al., 1999; the Alcohol Misuse Prevention Study (US)	• Age • Susceptibility to peer pressure to misbehave (reflects the extent of susceptibility to general misbehaviour)
21. Urberg et al., 2003 (US)	• Friendship conflict (measured by a friendship qualities scale) • Positive Quality of friendship (measured by a friendship qualities scale)

There were six peer-related moderators identified. Friendship reciprocity (when the respondents' friends also named the respondents in their friends' list), friends' sociometric popularity status (calculated by subtracting the number of "least popular" from the number of "most popular" nominations received from their class peers), and friendship stability (had the same best friend at T1 and T2) were studied by Bot and colleagues (2005). It was found that the drinking behaviour of a nonreciprocal friend with higher sociometric status exerted most influence in changing the intensity of drinking of respondents. Furthermore, Urberg and colleagues (2003) found that adolescents were influenced by their nominated best friend when they reported medium or high positive quality in their friendships, or when low conflict was reported in those relationships. Another peer factor identified as a moderator was peer similarity in drinking behaviour. Jaccard and colleagues (2005) found that peer effects were stronger when the target individual and peer shared similar drinking histories.

Marshal and Chassin (2000) tested the moderating effects of parental support and parental discipline and found these factors were protective for girls but exacerbated peer effects for boys. Crawford and Novak (2002) also tested two parental moderators: parental control and attachment. They found that high levels of parental control (when female students were in Grade 10) reduced lifetime alcohol use level among females, but increased levels of lifetime drinking among males, by the time they were in Grade 12. In addition, low parental attachment was found to reduce the likelihood of non-drinkers in Grade 10 in becoming binge-drinkers two years later, with this influence more pronounced for boys compared to girls. Moreover, Jaccard and colleagues (2005) identified another parental moderator, namely, satisfaction with maternal relationship. As the level of satisfaction with maternal relationship increased, the effect of peer binge drinking at T2 tended to decrease. Another parent-related moderator identified by Bray and colleagues (2003) was intergenerational individuation, which reflects a capacity to take responsibility for the self without being controlled by dominating parents. This construct significantly predicted changes in adolescent alcohol use;

higher initial status of intergenerational individuation was related to smaller increases in adolescent drinking.

Attempts were made to map the reviewed studies onto a Peer Process Model (PPM) which is shown in Figure 1.1. The paths and constructs that are supported by evidence extracted from the reviewed studies are shown in solid lines; whereas those paths and constructs that are shown in broken lines are suggested by developmental theories but have not been the subject of research validation. The confirmed paths are labelled with study number(s) (which can be found in Table 1.1 or 1.2) that provided support.

All studies, except for the studies done by Fergusson and colleagues (2002) and Wiesner and colleagues (2008), showed that friends' alcohol use at T1 predicted adolescent alcohol use at T2, which provided support for the path between "peer influence" and "high prevalence alcohol-related problems". Six studies showed that adolescents' own use of alcohol at baseline remained predictive of later alcohol use, even when friend's drinking was controlled for in regression analyses. Furthermore, nine studies, which were analysed by latent variable models or SEM, showed evidence for the effect of peer selection, i.e., adolescent drinking at T1 influenced their involvement with alcohol-using friends at T2.

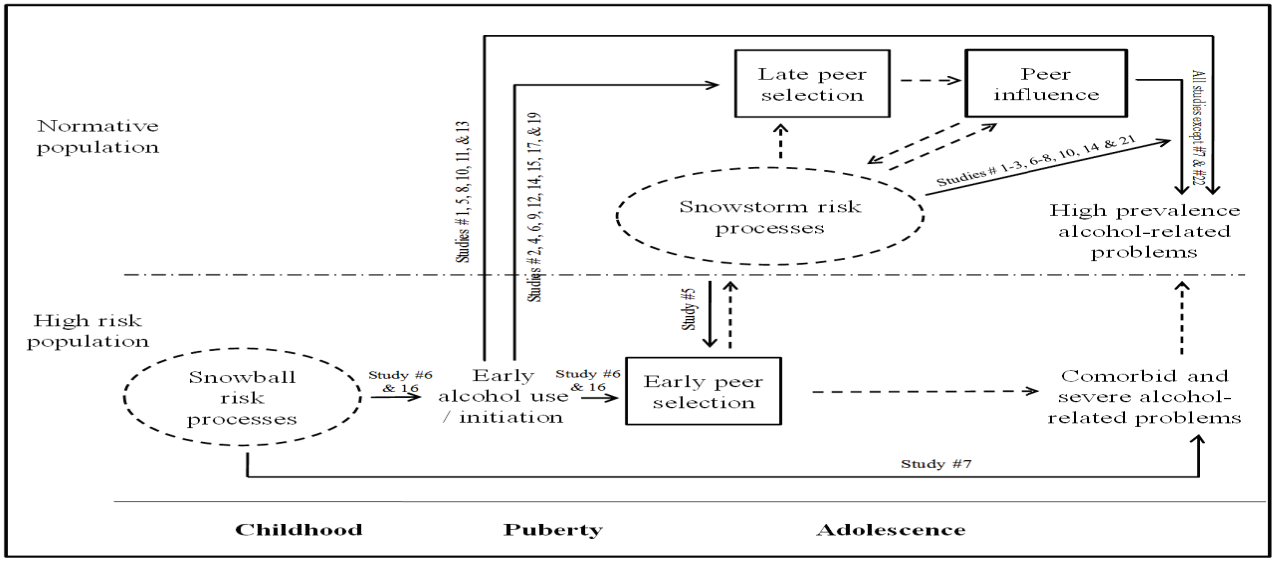

Figure 1.1. The Peer Process Model with paths supported by evidence extracted from the reviewed studies.

1.1.3 Discussion

This article is one of the first systematic reviews to examine the prospective association between exposure to peer factors and the development of adolescent alcohol-using behaviour. The review sought to disentangle the effect of peer influence relative to peer selection processes. A systematic search of studies published over the past fourteen years revealed that 22 relevant longitudinal studies had NOS quality ratings of 6 or higher. All but one study confirmed previous findings that exposure to alcohol-using or deviant peers is a consistent longitudinal predictor for the development of adolescent alcohol use. Eleven of the available studies used multivariate analytic methods to control for alternative influences providing evidence that exposure to peer alcohol use and/or deviant behaviours operates as a unique risk factor for the subsequent development of adolescent drinking behaviour.

Findings from the present review provide evidence that peer influence operates independently of peer selection processes in predicting adolescent alcohol use. Eight of the eleven studies that reported adjusted regression analyses (including GEE) found that peer exposure (influence) maintained a significant predictive effect after adjusting for prior alcohol use (a necessary condition for selection). While these eight studies isolated peer influence effects by statistically controlling for peer selection, six studies found that baseline alcohol use maintained a significant effect on subsequent alcohol use. Nonetheless, none of the reviewed studies were able to illuminate the underlying mechanisms of the reciprocal peer effects, whether young people self select themselves into alcohol-using peer groups because of their alcohol use or whether they are influenced by their drinking peers to start using alcohol. It is not clear which of the peer effects is more important at what age. Few studies quantified the number of young people that moved from alcohol use in the absence of friends to having alcohol-using friends (the clearest example of selection).

In the ten studies that used latent growth models and SEM to examine both peer processes, findings confirmed that both peer influence and selection processes have significant prospective effects on adolescent alcohol use; only Wiesner and colleagues (2008) did not find a significant lagged peer influence effect and the concurrent effect of peers that was found reflected a mixture of both peer influence and selection effects. While Curran and colleagues (1997) reported that respondents with more alcohol-using peers at baseline were found to have a higher rate of increase in their own use of alcohol over time, Bray and colleagues (2003) found smaller increases in youth drinking prospectively for respondents who reported higher levels of peer drinking at baseline, their effect partly explained by high baseline levels of alcohol use resulting in ceiling effects for future increases in youth drinking.

1.1.3.1 Evidence supporting a Peer Process Model

Since existing literature does not provide clear evidence in regards to the relative contributions of the peer influence and selection processes, a Peer Process Model (PPM) is proposed that can integrate existing longitudinal research to potentially serve as a theoretical guide in examining how these peer mechanisms operate at different age points throughout adolescence. Due to the quantity of predictors in different domains and large number of possible functional alternatives for relationships among these variables, specification of the relationships among predictors in explaining alcohol misuse must proceed theoretically (Lonczak et al., 2001). The PPM can also provide a framework for investigating risk/protective factors and moderators/mediators in research that is theoretically and developmentally driven.

1.1.3.2 Peer processes during early adolescence

The PPM acknowledges that, in contexts where alcohol use is rare in childhood, peer selection emerges after the pubertal transition into adolescence. Engles and colleagues (1999) found the impact of friends on respondents' alcohol

use and the impact of adolescents on friends' use were found at age 14 and 17 but perceived friends' use of alcohol at age 14 was not predictive of adolescent alcohol use at age 17. Their findings suggested that at age 14 peer selection had a larger effect on adolescent drinking behaviour. Note that peer selection at age 14 was independently influenced by parental alcohol use at age 12, which provides some support for the view that parental alcohol use may be part of the early age risk processes that influence adolescents to start drinking early. In their review Toumbourou and Catalano (2005) suggested that the cumulative number of early age risk factors can have an effect like a "snowball", whereby early risk factors such as maternal alcohol use during pregnancy and parental neglect can result in developmental vulnerability to later risk factors such as behaviour and school problems. This evidence was mapped onto the PPM to show that "snowball risk processes" lead to "early alcohol use", which in turn contribute to "early peer selection". Toumbourou and Catalano (2005) argued that the majority of adolescent users are not motivated by snowball risk trajectories, but by what they described as "snowstorm" risk processes. Even a healthy child may be placed at risk by threatening environmental conditions such as a snowstorm, with the chances of surviving increased if the child has protective factors such as suitable clothing. The environmental conditions in adolescence that increase the threat of adolescent alcohol use include tolerant norms and favourable attitudes, and behaviours in the community and peer group, while protective factors include attitudes and attachments that are unfavourable to alcohol use. The PPM postulates that snowstorm risk processes, particularly the proportion of peers using alcohol contribute to peer influence effects. This is partly supported by D'Amico and McCarthy (2006) in which they found the perception that many friends used alcohol predicted alcohol use onset among a group of middle school youth with a mean age of 12 years at baseline during an academic year (this relationship is shown in solid line accordingly in Figure 1.1).

The PPM integrates the finding that peer processes are impacted by the outcome of early development influences that establish clear identity directions and reduce susceptibility to peer processes. Peer influence and selection effects

were found in high- and medium-susceptibility groups but not in the low-susceptibility group by Schulenberg and colleagues (1999). Moreover, Sieving and colleagues (2000) showed that the effects of peer selection were only evident among adolescents in the intervention sample (which was exposed to the school- and community-based alcohol use prevention trial) and not in the reference sample. Based on a series of nested-model comparisons, the peer influence model was found to be the best fitting model for both sample of adolescents and thus their findings suggested that adolescent alcohol use is more related to processes of peer influence.

Although the PPM suggests that peer influence is more prominent among older adolescents, evidence was found among a sample of 6th graders in that the association with antisocial peers independently predicted the onset of alcohol use (Simons-Morton, 2004). This suggests that affiliations with antisocial peers may also be part of the snowball risk processes. Pubertal timing of these children was not reported by the author and it could be that those initiators were early maturers who seek out older peers and are more susceptible to peer influence. Another possible underlying mechanism is that early initiators are affected by family problems such as low parental attachment and family conflicts at home so that they become peer-oriented earlier compared to their peers on normative trajectories. Therefore, the findings provide further support for the path between "snowball risk processes" and "early alcohol use / initiation" in the PPM. This highlights the need for more research on the interplay between early life risk factors and its contribution to the development of adolescent alcohol use. In fact, etiological research that establish risk factors for initiation of alcohol use in preadolescence is rare because epidemiological surveys on alcohol and drugs tend to exclude children in elementary schools (Donovan et al., 2004). Moreover, the prevalence of past 30 days drinking in this sample increased from 5.5% at baseline to 12.6% six month later, confirming that early adolescence is a period of rapid changes in drinking behaviour. This is also a period when young people start experimenting with alcohol and drinking behaviour is less ingrained. Therefore, the need to target young people for prevention at the early stages of

selection (usually during late childhood and early adolescence) is warranted (Engels et al., 1999).

1.1.3.3 Peer influence during mid adolescence

Adolescents choose their peer friendship group partly to reduce the complexity of the peer context they experience (Arnett, 2007). Therefore, the PPM argues that the direction of effects begins with peer selection and from that point is increasingly multidirectional. Urberg and colleagues (2003) proposed to consider social contexts as dynamic in that the two processes operate reciprocally to produce change and continuity for the young person. The PPM incorporates the finding that peer selection processes generally tend to precede peer influences, however, the effects of peer influence and selection may show some variations in different groups of individuals and at different age levels. Indeed, Van Der Vorst and colleagues (2009) found that the best friends of increasers, stable drinkers, and heavy drinkers (drinking trajectories identified over three years) were more likely to use alcohol than the best friends of light drinkers, but not that of the abstainers among their sample of mid-adolescents. This suggested that best friends' alcohol consumption becomes important in reinforcing drinking patterns after adolescent initiation of drinking. These findings suggest that adolescent light drinkers may have started drinking in contexts such as family gatherings and not in the presence of friends. Furthermore, the PPM argues that the effects of peer influence tend to appear after puberty. Fergusson and colleagues (2002) showed that adolescents aged 14 to 15 were most susceptible to deviant peers. Engels and colleagues (1999) also found adolescents' own use of alcohol at age 14 was predicted by perceived friends' use at age 12. Future research should continue to investigate the hypothesis presented in the PPM to establish which of the two processes (selection or influence) operate more profoundly at different ages. Specification of these issues can assist the design of more creative and effective age-appropriate prevention strategies.

1.1.3.4 Adolescents on different risk trajectories

Li and colleagues (2002) identified two trajectory classes of alcohol users. They found peer influence was stronger for adolescents who reported relatively low levels of baseline alcohol use. In these groups significant lagged peer effects were observed on adolescents' alcohol use only from age 15 onwards. In contrast for adolescents in the high-average users group, the magnitude of the lagged peer effects were stronger at younger ages and then appeared to decrease each year after the age of 15. These findings lend support to the PPM in that the low-average users group resembled adolescents on normative trajectories and for these groups the initiation or increase of alcohol use was more associated with peer influence among older adolescents. Whereas the findings for the high-average users group provided partial support for the PPM hypothesis that the effect of peer selection is more profound among young people who are on high risk trajectories.

Research is needed to identify adolescents with different levels of risk trajectories which require different prevention approaches. For instance, adolescents with moderate levels of risk factors need prevention programs that are delivered at the whole-population level; as opposed to adolescents with snowball trajectories who need targeted intervention at an earlier age prior to the initiation of the development of problems (Toumbourou & Catalano, 2005). Moreover, peer processes are likely to operate differently among adolescents from different countries and ethnic groups due to the variation of prevalence of alcohol use, social norms and policies, and other cultural factors. As the majority of research has been conducted in the US, more studies are needed to investigate the impact of peer influence on alcohol use for young people from non-Caucasian racial groups and countries other than the US to better inform practitioners and policy makers to deliver effective and appropriate prevention programs.

1.1.4 Implications and conclusions

Although peer context is found to be very robust in predicting adolescent substance use (Bauman & Ennett, 1994), adolescent socialisation is also subject to complex social contexts involving family, school and the community that have the potential to modify peer influence and selection processes. To effectively prevent adolescent alcohol use and its harmful consequences at a population level, school and community engagement, parental involvement, and peer participation components must be included to address the wide range of factors influencing adolescent alcohol use (Sieving et al., 2000). The Social Development Model (Catalano & Hawkins, 1996) suggests that social ties may be rich sources of protection, capable in some contexts of partially or fully offsetting unhealthy behavioural choices and social influences. The Ecological System Theory (Bronfenbrenner & Morris, 1998) specifies four types of nested environmental systems, with the peer group, school, family, and community environment as the child's microsystem. The theory emphasises bi-directional influences within and between these systems through a mesosystem that connects these environments. The PPM proposed here provides specification as to the processes operating within the microsystem. These theoretical models seem to be appropriate in guiding future empirical studies investigating the effect of peer influence and selection processes on adolescent alcohol-using behaviour.

This review yields several implications for future research on peer influence and selection processes on adolescent drinking behaviour. Reducing peer selection effects requires a better understanding of factors that predict young people who, at a young age, actively seek out alcohol-using peers. The PPM posits that early selection is motivated partly due to snowball risk trajectories. However, parental toleration of early alcohol use also appears to influence selection. Research has shown that children who were first introduced to alcohol by parents or other relatives in a family context may be more likely to engage in peer selection (Donovan, 2007; Zucker et al., 2008). This implies that primary prevention to delay early onset of drinking should also target parents and

caregivers. The PPM also postulates that early peer selection leads to aggregation of alcohol-using peers that increases snowstorm trajectories in closed systems such as schools, thereby increasing the proportion of alcohol-using peers and hence peer influence. Changing settings and structures (e.g., classrooms and schools) that organise adolescent peer relations can lead to changes in peer contexts indirectly (Crosnoe & McNeely, 2008).

One important conclusion of the current review is that there has been inadequate research attention to potential moderating and mediating factors that may disrupt the effect of peer exposure on the development of alcohol use. Although nine studies identified five parental moderators, four of them found opposite effects for girls and boys. This underlines the importance of examining gender differences. It is interesting to note that Simons-Morton (2004) also tested three parental factors, namely, parental monitoring, involvement, and expectation and, in distinction to the predictions of the PPM, the author did not find peer influence on drinking initiation to be modified by these parental factors. More research is needed to confirm whether parental factors contribute directly or moderate the effect of peer influence on adolescent alcohol use (Morton et al., 2010). Few studies have identified protective factors that might moderate and/or mediate the effects of peer substance use on adolescent use (Hawkins et al., 1992). It seems clear that both influence and selection play a role in the growth of adolescent alcohol use but existing longitudinal studies have paid inadequate attention to moderating and mediating processes that modify the effect of peer influence and selection.

Limitations of the reviewed studies include the majority of the study participants were from the US and mainly Caucasians. Only six studies sampled adolescents from countries outside of the US and therefore there is uncertainty in generalising the study findings to adolescents from different ethnic and cultural backgrounds. The attrition rates ranged from 1% to 33% among 14 studies with four studies reporting attrition above 20%. Attempts should be made, such as compensation for the time participants spend contributing to the research and

collection of detailed contact information from participants, to minimise attrition and to preserve the representativeness of the original study sample. Four reviewed studies used national datasets with panel data collected in the 1970s and 1980s. Although it is convenient and cost-effective for secondary analyses to utilise such large-scale datasets, results generated may be potentially less relevant to present-day adolescents' drinking behaviour. Furthermore, most of the studies were not designed to test a particular theory. It is important to conduct theory-driven research as theory hypothesises the causal relationships among variables that increase or decrease adolescent alcohol use and provides a framework to explain the underlying peer mechanisms (Hawkins et al., 1992).

In conclusion, the present review highlights the need for further studies to examine the relative contribution and directionality of peer influence and selection mechanisms on adolescent alcohol use. Continued identification of factors that moderate and/or mediate the effects of the peer processes at different developmental stages and in different social environments is important. The proposed PPM offers theoretical guidance for future research to more comprehensively investigate how peer processes operate and in this way encourages the design of effective prevention programs that are appropriate for adolescents in different age groups and social contexts[1].

This chapter described a systematic review of longitudinal studies that examined the effect of peer mechanisms on the development of adolescent alcohol use. The PPM was proposed as a framework to integrate findings to date, to indicate gaps in the literature and to guide further research endeavours. Chapter 2 provides a detailed consideration as to how the PPM can be used as a theoretical guide to further research. The chapter considers the selection of appropriate statistical techniques to test hypotheses postulated by the PPM, and the use of longitudinal data to examine the relative contribution of the peer processes at different age cohorts during early adolescence.

[1] End of the published systematic literature review.

Chapter Two: Methods and data description

This chapter commences by discussing the advantages and rationale of adopting person-oriented approaches in alcohol research. Being person-oriented analytic methods, latent class analysis (LCA) and latent transition analysis (LTA) are proposed to provide an appropriate means of operationalising and testing predictions from the PPM. The close correspondence of LCA and LTA models and the PPM is discussed. The chapter also presents a technical description of LCA, which describes population heterogeneity by identifying meaningful and discrete latent subgroups that have common responses across variables; and LTA, which describes changes or movements between these latent subgroups over time. Using the PPM as a theoretical guide, empirical analyses were planned to investigate the relative contribution of the effect of peer influence and selection mechanisms on the development of adolescent alcohol use.

The chapter also introduces the International Youth Development Study (IYDS) from which longitudinal data from three cohorts of early adolescents were used for the planned empirical analyses. A description of the measures of adolescents' and their peers' drinking statuses and other alcohol related items that were used to identify heterogeneous group response patterns to peer group and alcohol use constructs were presented. Selected covariates that were tested as constructs of the snowball and snowstorm risk processes proposed by the PPM are also described. The chapter ends with a series of analytic strategies that were completed to achieve the objectives of the empirical study.

2.1 Methodology

2.1.1 Person-oriented approach in substance use research

LCA and LTA are regarded as a type of person-oriented analytic models. One of the premises of person-oriented approaches is that populations are heterogeneous and distinct subgroups may exist (von Eye & Bogat, 2006). In contrast, variable-oriented approaches (e.g. factor analysis) operate under the assumption that populations are homogenous. The focus of such approaches is on describing associations among variables and it is assumed that these associations are applicable to all individuals in the study population (Collins & Lanza, 2010; Laursen & Hoff, 2006; von Eye & Bogat, 2006). The emphasis of person-oriented approaches is to identify groups of individuals who share similar patterns of individual characteristics. These analytic models often involve studying similarities within groups of individuals and differences between groups, and describing differences among individuals in how variables are related to each other (Collins & Lanza, 2010; Laursen & Hoff, 2006).

LCA has been applied to many substantive research areas to capture unobserved heterogeneity in sample populations, especially among children and adolescents. For example, LCA has been utilised to study patterns of community violence exposure among a community sample of African American early adolescents (Lambert, Nylund-Gibson, Copeland-Linder, & Ialongo, 2010), to examine solution strategies of the Mental Rotation Test in a sample of German pupils and students (Geiser, Lehmann, & Eid, 2006), and to identify peer victimisation groups in a sample of public middle school students (Nylund, Bellmore, Nishina, & Graham, 2007).

As relevant to the present study, a latent class variable is often used to organise multiple dimensions of substance use behaviours among adolescents. For example, Reboussin and colleagues (2006) characterised the variation in patterns of underage drinking in a community sample of adolescents. Cleveland

and colleagues (2010) classified Grade 12 students into subgroups according to their experience with alcohol, cigarette, and marijuana use to study how individual risk factors interact with protective factors in different social contexts to predict problematic substance use. In another application, Wells and colleagues (2004) described drinking patterns of 16 year-old participants in a birth cohort study and examined how these drinking patterns associated with a range of psychosocial outcomes (e.g. education and employment outcomes, and depression and anxiety diagnoses) in their late adolescence and early adulthood.

Similarly, LTA has gained popularity in recent years and been utilised to examine transitions in substance use and high-risk health behaviours among adolescents. For instance, Palen and colleagues (2009) applied LTA to examine the transitions in new risk behaviours in a sample of high school students in a low-income township in South Africa. Their results revealed that these at-risk students were more likely to initiate substance use as their first risk behaviour, before transitioning to sexual intercourse at a later time point. Lanza and Collins (2002) investigated whether early maturers were at increased risk for substance use onset, compared to on-time/late maturers, in a national sample of female adolescents in the United States (US). It was found that early maturers were significantly more likely to be in the most advanced stages of substance use in Grade 7; also they were more likely to advance in substance use during the transition to Grade 8, regardless of their level of use in the previous year.

Moreover, one unique application of LTA is to study stage-sequential developmental processes in adolescent substance use. Since LTA describes movement between discrete stages over time, the latent variable is regarded as a stage-sequential dynamic latent variable in which change is expressed in terms of transition probabilities (Collins & Flaherty, 2002). It has been proposed that substance use onset is best examined as a dynamic process and it has been demonstrated that it is appropriate to conceptualise adolescent substance use as progressive, stage-like processes (Graham, Collins, Wugalter, Chung, & Hansen, 1991; Lanza & Collins, 2002; Spoth, Reyes, Redmond, & Shin, 1999). In the

context of alcohol use, stage-sequential theories have suggested that the development of drinking behaviour starts with occasional experimentation with alcohol, then progresses to more frequent use and subsequently to heavier consumption when alcohol use becomes habitual due to increased dose-tolerance to alcohol (Mason et al., 2011). An example of such application is the study of the Gateway Hypothesis of drug use (Kandel & Jessor, 2002; Kandel, Yamaguchi, & Chen, 1992). According to the gateway hypothesis, alcohol and tobacco are gateway drugs that lead to the use of marijuana and other illicit substances. LTA has been applied to operationalise the gateway hypothesis to investigate the development of substance use among adolescents (e.g. Collins, 2002; Maldonado-Molina & Lanza, 2010). These studies provided evidence to support the notion that alcohol and cigarettes act as gateway drugs for experimentation with marijuana and that alcohol served as the gateway drug for tobacco use.

2.1.1.1 Rationale for adopting a person-oriented approach

Most studies included in the systematic review in the previous chapter used variable-oriented methods to analyse the prospective effect of substance use or deviant peers on adolescent alcohol use and results were unable to illustrate the relative contribution and developmental sequence of peer influence and selection processes. Among these reviewed studies, only two studies utilised person-oriented approaches to identify risky drinking trajectories (Li et al., 2002; van der Vorst et al., 2009). These studies classified adolescents into different risky drinking trajectories according to their level of use and were able to show the differential effects of peer processes or the likelihood of having alcohol-using peers across drinking trajectories. However, the results revealed drinking trajectories over a period of three to five years and were not able to show more proximal changes, especially the proportion and characteristics of youth who move on to more risky drinking trajectories over brief time periods. It is possible that subtle changes in alcohol consumption happen during shorter time periods as drinking behaviours among adolescents are less ingrained compare to that of adults. Given the developmental sequence of the effect of peer mechanisms were

not elucidated clearly in the existing longitudinal literature, a different type of person-oriented analysis that captures subtle differences between subgroups of individuals (inter-individual) and differences over a shorter period of time (intra-individual), e.g. time-to-time transitions, is necessary.

LCA and LTA, being person-oriented methods, are theoretically appropriate techniques for examining group differences in the effect of peer influence and selection processes on the development of alcohol use through adolescence. LCA describes the heterogeneity of a population by assigning individuals into discrete subgroups and LTA permits the testing of hypotheses related to sequential transitions. To date, few studies have modelled peer mechanisms and the development of adolescent alcohol drinking behaviour simultaneously using LTA. There are several advantages of using LCA and LTA over other alternatives, such as cluster analysis. First, LCA and LTA are probabilistic models and subgroups are identified based on individuals' item-response probability profiles. Hence, arbitrary cut-off points or external criterion are not required (Nylund, 2008). Second, this latent class approach generates more accurate estimates of the transition probability matrix and other model estimates by modelling measurement error (Collins, 2006). Third, LCA and LTA can make large, complex contingency tables interpretable for developmental science (Lanza & Collins, 2008). Fourth, these methods allow investigators to model latent variables that are informed by multiple dimensions of behaviours; oftentimes complex behaviours cannot be easily measured by a single questionnaire item (Lanza & Bray, 2010). Fifth, important demographic predictors and contextual risk and protective factors can be incorporated in LCA and LTA to further inform details as to how predictors are related to change within different subgroups. Compared to variable-oriented methods, LCA and LTA provide a more nuanced portrait of the development of adolescent alcohol use in the presence or absence of varied peer group characteristics.

2.1.1.2 Correspondence between the PPM and LTA

In prevention science applications of alcohol research, person-oriented approaches are appropriate because data often include heterogeneous subgroups of individuals at different stages in the development of alcohol behaviour (e.g. experimenters, frequent drinkers, and heavy drinkers) and the recognition of heterogeneity has led to theories of multiple developmental pathways (Muthen & Muthen, 2000). Indeed, the PPM (Figure 1.1) hypothesises that the effects of peer processes operate differently on individuals from normative populations relative to those who are from high risk populations. According to the PPM, peer selection processes generally precede peer influence processes in early alcohol initiation within a specific population. However, individuals from high risk populations are posited to start drinking due to snowball risk processes experienced in childhood. By incorporating childhood risk factors into an LTA, that are indicated by high levels of family risk in areas such as poor family management practices and family conflicts, predictors can be identified that may be of specific relevance to predicting alcohol use within groups that are characterised by high levels on snowball risk factors. Using LCA and LTA methods, the prevalence and characteristics of these high-risk children and their probability of transitioning into early alcohol use and subsequent selection of alcohol-using peers at Time 2 can be estimated.

In addition, the PPM postulates that late peer selection and peer influence processes emerge around mid-adolescence in a normative population. This sequential order of peer influence and selection processes can be investigated by operationalising peers' and adolescents' drinking behaviours as a stage-sequential dynamic latent variable. Since adolescent alcohol use is a multifaceted phenomenon, the latent variable is inferred by the number of best friends who use alcohol, the frequency of alcohol consumption by adolescents, on a bi-weekly, monthly, yearly, and lifetime basis, as well as their positive attitudes towards alcohol and whether they would accept alcoholic drinks offered by their friends at parties. LCA has the potential to classify adolescents into discrete peer subgroups

that have relevance to the PPM (e.g. non-drinkers who have drinking friends or alcohol experimenters who have non-drinking friends at Time 1). Given that LTA estimates the probability of transitioning between these discrete peer groups between two time points, it offers the opportunity to test longitudinal predictions from the PPM. The relative importance of the posited peer processes can be revealed by transition probabilities. Peer influence processes can be identified in transitions between peer subgroups where non-drinking adolescents who had drinking peers at Time 1 transition to drinking at a later time point. Further, peer selection processes can be identified in peer subgroups where adolescents who had initiated alcohol in the absence of drinking peers at Time 1, transition to having drinking peers at Time 2. The PPM also acknowledges that the magnitude and direction of the effect of peer processes changes over time, and that peer influence processes play a larger role among older adolescents and appear after puberty.

Using prospective data from three cohorts of participants (Grades 5, 7, and 9 at baseline) from the International Youth Development Study (IYDS, described in more detail in Section 2.2.1), results from different age groups can answer questions such as which peer processes are more prominent in which age group, and the order of appearance of the peer processes at different points during adolescence. One major benefit of the IYDS dataset is the bi-national data collect from a matched sample of adolescents from the state of Victoria, Australia, and Washington State, US. Since most of the studies included in the literature review were conducted with adolescents from the US, results from cross-national comparisons can help identify whether peer processes are culturally similar or alternatively are subject to cultural variation. Such comparisons may reveal appropriate points for tailoring specific interventions in different country contexts.

Conceptualising peer mechanisms and adolescent drinking behaviour as stage-sequential terms provides insights about prevention efforts (Graham et al., 1991; Lanza & Collins, 2002). Universal prevention, which aims to delay the initiation of alcohol use, can be applied to all early age groups that include non-

drinking individuals who are likely to be eventually exposed to drinking peers. Selective prevention, which aims to halt or reverse a risk process that has already started, can target interventions at individuals who are classified into latent subgroups groups and identified by transition probabilities to have a high probability of advancing to alcohol use and heavy use in order to lower their incidence of progression.

2.1.2 Latent class analysis

Latent class analysis (LCA) was introduced by Lazarsfeld and Henry (1968) for the purpose of building typologies based on dichotomous survey items (Collins & Lanza, 2010; Kaplan, 2008; Vermunt & Magidson, 2004). LCA is a multivariate statistical modelling technique that is based on a measurement theory which posits that an underlying grouping variable, i.e., a latent class variable, that is not directly observed can be inferred from the values of a set of categorical indicators (also known as observed or manifested variables; Lanza, Patrick, & Maggs, 2010; Lazarsfeld & Henry, 1968; Nylund, 2008). Figure 2.1 shows a general latent class model diagram in which C represents a latent class variable and u represents an observed binary variable. LCA is a cross-sectional data analytic technique which aims to classify individuals into meaningful homogenous subgroups that exhibit similar patterns of characteristics or behaviours. LCA operates on the assumption that an individual belongs to one and only one latent class (sometimes referred to as latent groups, states, statuses, or stages) and that the observed variables are independent of one another, conditional on the individual's latent class membership, known as local independence (Collins & Lanza, 2010; Kaplan, 2008). In other words, the association between the observed variables is explained through the classes of the latent variable (McCutcheon, 1987). Conceptually analogous to factor analysis, LCA also uses a latent variable to describe the relationship among a set of observed items. However, the key difference is that the latent variable in LCA is categorical and has a multinomial distribution; whereas in factor analysis the

latent variable is continuous and is normally distributed (Collins & Lanza, 2010). Another difference between the models lies within the indicators: they are treated as continuous in factor analysis, while in LCA indicators are treated as categorical.

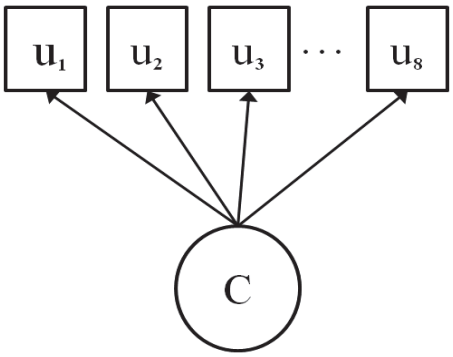

Figure 2.1. A general latent class variable diagram with eight observed binary variables.

2.1.2.1 LCA model parameters

Two sets of parameters are estimated in LCA: latent class membership probabilities, also known as latent class prevalences, which is the probability of membership in each latent class; and a matrix of item-response probabilities, representing the probability of each response ("Yes" or "No") to each observed indicator for each latent class (Collins & Lanza, 2010). The labelling and interpretation of latent classes are based on the item-response probabilities. In addition, to be useful and meaningful latent classes must also be interpreted with reference to substantive theory (von Eye & Bogat, 2006). Often, LCA models reveal both meaningful qualitative (e.g., latent classes characterised by different types of substance use behaviours) and quantitative (e.g., differences in the frequency and amount of substance use) differences among latent classes.

2.1.3 Latent transition analysis

An important extension of LCA is latent transition analysis (LTA), which includes modelling of longitudinal data and transitions between latent class variables at two consecutive time points (Collins & Lanza, 2010). LTA builds on LCA models and autoregressive modelling, specifically Markov models (Nylund, 2008). Markov models assume that predicting the current state of an individual depends upon the immediate occasion previously and not any other states prior to the immediate past observation (Guo, Aveyard, Fielding, & Sutton, 2009; Kaplan, 2008). Figure 2.2 shows a diagram of an LTA model with eight observed binary variables and two measurement points. LCA is usually used as a measurement model in LTA to identify discrete latent classes at each time point (C with subscripts of 1 and 2 denote latent class variables at Time 1 and Time 2 respectively). The autoregressive element of the LTA models transitions between latent class memberships over time (Nylund, 2008). In addition to scientific questions regarding the number, type, and prevalence of latent classes that can be examined by LCA, LTA provides information relevant to the probability of change between latent classes over time (Collins & Lanza, 2010; Muthen & Muthen, 2000). That is, LTA estimates the probability of transitioning to other latent classes or staying in the same latent class at Time 2, given individuals' classifications in a particular latent class at Time 1. In contrast to growth curve modelling where change over time is characterised by a mean-level function of time such as linear or quadratic growth, change in LTA is characterised by movements between discrete stages across time (Lanza & Bray, 2010). LTA is an appropriate tool to investigate phenomena where numerous discrete classes or states are involved, the states are inferred by multiple observed indicators, and individuals can transition freely among the states (Collins, 2006).

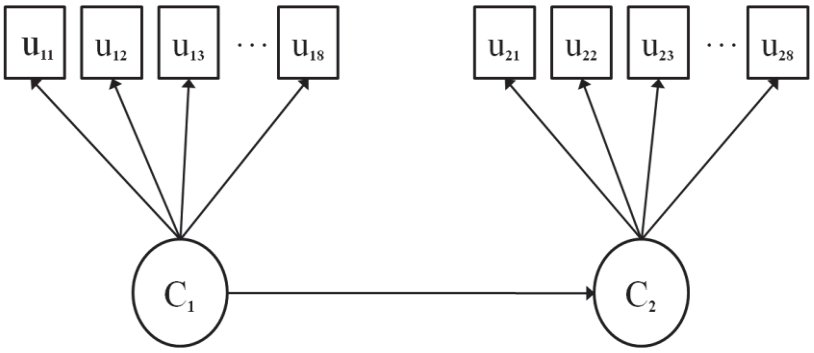

Figure 2.2. A latent transition model diagram with eight observed binary variables and two measurement points.

2.1.3.1 LTA model parameters

In addition to the latent class prevalences and item-response probabilities estimated by LCA, LTA estimates a matrix of transition probabilities, reflecting the incidence of transitions from one occasion to a later occasion (Collins & Lanza, 2010). The transition probabilities also express how change occurs between latent statuses over time. In LTA, the latent classes are often referred to as latent statuses, reflecting that individuals have a latent probability of changing membership across latent classes over time (Lanza, Patrick, et al., 2010). This is different compared to LCA, where the latent variable is static and the latent classes represent stable sets of characteristics or states of behaviours. To be consistent with terminology, latent status is used when reporting the results of LTA models to indicate the assumption that latent subgroup membership has an estimable probability of change over time.

2.1.3.2 LTA with covariates

Covariates, or predictors, can be introduced into LTA models to identify characteristics that predict latent status membership at Time 1 or predict transitions between latent statuses over time using a logistic regression approach

(Collins & Lanza, 2010). When one or more covariates are included, two additional sets of parameters can be estimated: (1) a set of beta parameters that are logistic regression coefficients for each covariate that predicts Time 1 latent status membership; and (2) covariates predicting transitions over time (Lanza & Collins, 2008). When one or more covariates are incorporated, latent status prevalences and transition probabilities are not estimated; these parameters are expressed as functions of the regression coefficients and individuals' values on the corresponding covariates (Collins & Lanza, 2010).

All parameters in both LCA and LTA models are estimated by maximum likelihood (ML) using Expectation-Maximisation (EM) algorithm (Dempster, Laird, & Rubin, 1977), with Newton-Raphson algorithm incorporated for LTA models with covariates (Lanza & Collins, 2008). These procedure searches for the ML parameter estimates that represent the parameter value that the data are most likely to be observed. The EM algorithm iterates until the maximum number of iterations is reached or the search is close enough to a set of parameter estimates that maximises or nearly maximises the likelihood function (Collins & Lanza, 2010).

2.2 Aims of the empirical study

The overall aim of the empirical study was to examine the relative contribution of peer influence and selection processes in the development of adolescent alcohol use and to test theoretical propositions emerging from the PPM. In particular, results will fill the gap in the literature by reporting the proportion of youth who initiated alcohol use in the presence of drinking peers one year prior (peer influence process), and those who had started using alcohol on their own and self-selected into drinking peer groups one year later (peer selection process). The specific study objectives were the following: (1) empirically derive latent subgroups of adolescents based on their self-reported drinking status and that of their best friends and examine their peer group

patterns; (2) model transitions between these latent peer subgroups over two time points; (3) identify risk and protective factors that predict latent peer subgroup patterns at Time 1, as well as transitions over time; (4) examine and compare differences across two states in terms of latent subgroups prevalence, incidence of transitions over time, and predictors identified for each country. Ethics approval for the empirical study was granted by the Human Research Ethics Committee at Deakin University. A copy of the ethics approval is attached in Appendix A.

2.2.1 International Youth Development Study

Data were collected from students who participated in the IYDS, a cross-national prospective investigation of a range of adolescent behaviours including alcohol and drug use in state-representative samples in Victoria, Australia, and Washington State, US (Hemphill, Toumbourou, Herrenkohl, McMorris, & Catalano, 2006). Participants were first surveyed in 2002 when they were in Grades 5, 7, and 9. Student samples were chosen from Victoria and Washington State due to their similarities on a number of demographic and economic characteristics. Both states had similar populations (4.6 million in Victoria vs. 5.9 million in Washington State in 2001) at the time study commenced with comparable proportion of residents living in urban centres (80% in Victoria vs. 82% in Washington State) and equal distribution of females and males (McMorris et al., 2007). They have higher than national levels of educational participation and in national terms are relatively prosperous; median household income was AUD$46,774 and US$45,776 in 2001, in Victoria and Washington State respectively, with similarly low proportion of residents (~11% in both states) living in poverty (Hemphill et al., 2007; Toumbourou et al., 2009). The two states also share similar demographics of their school-age youth populations (McMorris et al., 2007). Regarding alcohol and drug use policies, however, the two states adopt different approaches. Australia adopts a harm minimisation approach that aims to minimise harmful consequences associated with substance use to individuals and society rather than reducing substance use per se, while abstinence

may be included it is not the policy focus. In contrast, the US adopts a zero-tolerance approach which focuses on abstinence and delaying substance use onset among children and young people (McMorris et al., 2007). In addition, the legal drinking age also differs; it is age 18 and 21 respectively for all states in Australia and the US.

The IYDS student survey is a self-report instrument that is adapted and extended from the Communities That Care (CTC) Youth Survey which assess a broad array of risk and protective factors predictive of problem behaviours, including substance use (Arthur, Hawkins, Pollard, Catalano, & Baglioni, 2002). The CTC survey has good reliability and cross-sectional validity in large samples of students in Grades 6 to 12 in the US (Glaser, Van Horn, Arthur, Hawkins, & Catalano, 2005). To ensure that the instrument was appropriate for young adolescents and applicable in the Australian context, pilot testing including language review was essential. In 2000 to 2001, pilot testing for survey measures and administration procedures occurred following recommended guidelines for cross-national instrument adaptation (McMorris et al., 2007). Results from language review and cognitive pretesting with small groups of adolescents in Grades 5 and 7 led to the design of a simplified, shorter version for fifth graders. A pilot administration of the modified student survey was then conducted with samples of more than 300 students in the targeted grades in each state. Findings were then used to revise and finalise measures and procedures (McMorris et al., 2007). Surveys were coordinated and implemented by study staff from the Social Development Research Group at the University of Washington in Seattle and the Centre for Adolescent Health at the Murdoch Childrens Research Institute, Royal Children's Hospital, and the University of Melbourne. Data collection personnel were trained in a single protocol to minimise differences introduced by different data collection procedures. The first wave of data collection was implemented in 2002. IYDS used a rigorous design, standardised procedures for participant recruitment, survey development and administration that overcomes the methodological limitations presented by previous cross-national comparisons (Hemphill et al., 2006).

2.2.1.1 Participants

In 2002, a two-stage cluster sampling approach was used for school and student recruitment where schools were randomly selected in the first stage and a target classroom within each school was randomly chosen in the second stage (McMorris et al., 2007). One hundred and fifty-two and 153 schools agreed to participate in Victoria and Washington State respectively. A probability proportionate to grade-level size sampling procedure was used to randomly select public and private schools containing Grades 5, 7, or 9 within each state and grade level. At each school a list of classes for the chosen grade level was obtained from the principal or contact person for recruitment (all classes for Grade 5; mandatory English classes for Grades 7 and 9). Each class was then assigned a number. A class was selected to participate if its assigned number matched the random number created by using the Microsoft random number generator function. Across the three age cohorts, 3,926 students were eligible for consent and survey administration, of whom 2,884 (73.5%) participated in Victoria. Classes in Washington State yielded a total of 3,856 eligible students, of whom 2,885 (74.8%) consented and participated in the survey. Parents provided written consent for their child to complete the questionnaire. Retention rates at 1-year follow up in 2003 were 99% in both states (Hemphill et al., 2006).

Table 2.1 presents the sample size, gender, and age of each cohort by state at baseline. The sample size in each grade level was comparable in the two states. Victoria had a higher proportion of female participants compared to that of Washington State. There were slightly more females than males in each cohort, except in Grade 9 in Washington State. Participants in Washington State were slightly older than that of their counterparts in Victoria (see Table 2.1).

Table 2.1
Demographics of each cohort at baseline by state.

Demographics	Grade 5	Grade 7	Grade 9
		Victoria	
Sample size	875	958	961
Female (%)	461 (52.7)	492 (51.4)	505 (52.5)
Age			
Range	9.8 – 12.4	11.8 – 14.5	13.7 – 16.5
Mean (SD)	11.0 (0.4)	12.9 (0.4)	14.9 (0.4)
		Washington State	
Sample size	889	947	975
Female (%)	457 (51.5)	481 (50.8)	485 (49.7)
Age			
Range	9.7 – 12.9	12.0 – 15.2	13.6 – 17.2
Mean (SD)	11.1 (0.4)	13.1 (0.4)	15.1 (0.5)

2.2.1.2 Survey administration

Surveys in 2002 and longitudinal follow-up surveys in 2003 were administered in February to June in Washington State and in May to November in Victoria to maintain seasonal equivalent of data collection periods and to account for state differences in the start of the school year. Surveys were group administered in classrooms during a 50- to 60-minute session. Students absent from school were surveyed under the supervision of trained school personnel or in a small percentage of cases (less than 3% at the first assessment, less than 4% at 1-year follow-up), over the telephone by study staff. Victorian students received small thank-you gifts (a small pocket calculator upon return of their consent forms in 2002 and a stress ball after completing the survey in 2003); whereas students in Washington State received $10 upon completion of the questionnaire. Protocols were approved by the Royal Children's Hospital Ethics in Human Research Committee (Victoria) and the University of Washington Human Subjects Review Committee (Washington State). Permission to conduct research in schools in Victoria was obtained from the Department of Education and Training for government (public) schools and the Catholic Education Office for some private schools, and then from principals. In Washington State, permission was obtained

from the school districts containing sampled schools and then from principals (McMorris et al., 2007).

2.2.2 Measures

2.2.2.1 Alcohol measures

Eight items from the IYDS survey were chosen to inform a latent variable representing the drinking statuses of adolescents and that of their peers at each time point and in each age cohort. Table 2.2 shows the wording of the eight binary indicators at Times 1 (2002) and 2 (2003) in each cohort. Drinking statuses of participants were informed by their self-reported alcohol use frequency in the past 30 days, in the past year, and in their lifetime. Peers' drinking statuses were measured by the item asking participants to report the number of best friends who drank alcohol. Older participants, those in Grades 7 to 10, were also asked if they engaged in binge drinking (one or more episodes consuming five or more alcoholic drinks) during the past 2 weeks. For 5^{th} and 6^{th} graders, students were asked if they had ever been drunk and whether this occurred in the past year, respectively. In addition to these alcohol use items, two items were chosen asking participants whether they would accept an alcoholic drink offered by a friend at a party, and whether they thought they would be seen as cool if they started drinking regularly.

Table 2.2
Survey items selected as measures for adolescents' and their peers' drinking statuses.

Indicator of latent peer groups based on drinking status of adolescents and their peers	Grade 5 & 6	Grade 7 & 8	Grade 9 & 10
No drinking friends: In the past year (12 months) how many of your best friends have tried alcohol (like beer, wine, or liquor) when their parents didn't know about it? 0 - 1 to 4 of my friends 1 - None of my friends	✓	✓	✓
1 to 2 drinking friends: In the past year (12 months) how many of your best friends have tried alcohol (like beer, wine, or liquor) when their parents didn't know about it? 0 - 0, 3 to 4 of my friends 1 - 1 to 2 of my friends	✓	✓	✓
3 to 4 drinking friends: In the past year (12 months) how many of your best friends have tried alcohol (like beer, wine, or liquor) when their parents didn't know about it? 0 - 0 to 2 of my friends 1 - 3 or 4 of my friends	✓	✓	✓

Table 2.2 (continued)

Indicator of latent peer groups based on drinking status of adolescents and their peers	Grade 5 & 6	Grade 7 & 8	Grade 9 & 10
Drink if friend offered at party: Imagine the situation: You are at someone's house, and one of your friends offers you a drink containing alcohol. What would you say or do? Would you… 0 - Tell your friend "No thanks, I don't drink" and suggest that you and your friend go and do something else, just say "No, thanks" and walk away , or make up a good excuse, tell your friend you had something else to do and leave 1 - Drink it	✓	✓	✓
Be seen as cool if drink regularly: What are the chances you would be seen as cool if you began drinking alcoholic beverages regularly, that is, at least once or twice a month? 0 - Very little or no chance 1 - Little to very good chance	✓	✓	✓
Ever drunk: Have you ever gotten drunk? 0 - No, never 1 - Yes, but not in the last year or one or more times in the last year	✓	x	x
Drunk during the past year: In the past year (12 months), on how many occasions (if any) have you gotten drunk? 0 - Never 1 - 1 or more times	✓	x	x

Table 2.2 (continued)

Indicator of latent peer groups based on drinking status of adolescents and their peers	Grade 5 & 6	Grade 7 & 8	Grade 9 & 10
Bingeing during the past 2 weeks: Think back over the last 2 weeks. How many times have you had 5 or more alcoholic drinks in a row? 0 - None 1 - Once or more times	x	✓	✓
Past 30 days use: In the past 30 days, on how many occasions (if any) have you had more than just a Few sips of an alcoholic beverage (like beer, wine, or spirits)? 0 - Never 1 - 1 or more times	✓	✓	✓
Past year alcohol use: In the past year (12 months), on how many occasions (if any) have you had more than just a few sips of an alcoholic beverage (like beer, wine, or spirits)? 0 - Never 1 - 1 or more times	✓	✓	✓
Life time alcohol use: In your lifetime, on how many occasions (if any) have you had more than just a few sips of an alcoholic beverage (like beer, wine, liquor)? 0 - Never 1 - 1 or more times	✓	✓	✓

Note. ✓ = measured in the respective cohort. x = not measured in the respective cohort.

2.2.2.1.1 ***Binary indicators measuring latent variable at both time points***

Participants reported the number of their best friends who have tried alcohol when their parents did not know about it in the past year at both time points and in each cohort. Response options ranged from 1 "None of my friends" to 5 "4 of my friends". The item was then recoded to generate three binary indicators: *No drinking friends* (coded 1 for "None of my friends" and 0 for "1 to 4 of my friends"), *1 to 2 drinking friends* (coded 1 for "1 to 2 of my friends" and 0 for "0, 3 to 4 of my friends"), and *3 to 4 drinking friends* (coded 1 for "3 to 4 of my friends" and 0 for "0 to 2 of my friends").

Drink if friend offered at party was measured by asking participants what they would do in a situation where they were at someone's house and a friend offered an alcoholic drink to them. Response options were 1 "Drink it", 2 "Tell your friend "No thanks, I don't drink" and suggest that you and your friend go and do something else", 3 "Just say "No, thanks" and walk away", and 4 "Make up a good excuse, tell you friend you had something else to do, and leave". The item was then dichotomised as 1 equal "Drink it" and 0 equal all other responses.

Be seen as cool if drink regularly was measured by asking respondents to estimate the chances that they would be seen cool if they began drinking alcoholic beverages regularly, i.e., at least once or twice a month. Response options were 1 "Very good chance", 2 "Pretty good chance", 3 "Some chance", 4 "Little chance", and 5 "Very little to no chance". The item was then recoded as a binary indicator (coded 1 for "Very little to no chance" and 0 for "Little to very good chance").

Ever drunk was measured among Grades 5 and 6 students only. They were asked in Grade 5 whether they have ever gotten drunk before. Response options were 1 "No, never", 2 "Yes, but not in the last year", 3 "Yes, 1 or 2 times in the last year", and 4 "Yes, 3 or more times in the last year". The item was then dichotomised as 1 for "Yes, but not in the last year or one or more times in the last year" and 0 for "No, never" to create a binary indicator *Ever drunk*. Respondents

were followed up with a similar question regarding the number of occasions that they have gotten drunk in the past year in Grade 6, with response options ranging from 1 "Never" to 8 "40 or more times". This item was recoded to create a binary indicator *Drunk during the past year* (coded 1 for "1 or more times" and 0 for "Never") in Grade 6.

Binge drinking during the past 2 weeks was measured among students from Grades 7 and 9 and they were followed up with the same questions one year later. Students self-reported the number of times they had 5 or more alcoholic drinks in a row during the past 2 weeks. Response options ranged from 1 "None" to 6 "10 or more times". The items at both time points were dichotomised as 1 for "Once or more times" and 0 for "None".

Alcohol use was measured by asking participants to report the number of occasions they had had more than just a few sips of an alcoholic drink in the past 30 days, past year, and in their lifetime. In Grade 5, the response options for the lifetime alcohol use item were 1 "No, never", 2 "Yes, but not in the last year", 3 "Yes, 1 or 2 times last year", 4 "Yes, 3 or more times in the past year". This item was recoded to create two binary indicators: *Past year alcohol use* (coded 1 for "Yes, 1 or more times" and 0 for "Never") and *Lifetime alcohol use* (coded 1 for "Yes, 1 or more times" and 0 for "Never"). Data on *Past 30 days alcohol use* was not collected from 5th graders. From Grades 6 to 10, the response options for the alcohol use items ranged from 1 "Never" to 8 "40 or more times". The items were dichotomised as 1 "1 or more times" and 0 "Never" for *Past 30 days alcohol use*, *Past year alcohol use*, and *Lifetime alcohol use*. For Time 2 for each age cohort, i.e., Grades 6, 8, and 10, *Past 30 days alcohol use* and *Past year alcohol use* were used. For Grades 7 and 9, *Past 30 days alcohol use* and *Lifetime alcohol use* were used.

2.2.2.2 Covariates

Covariates were selected to test the constructs of snowball and snowstorm risk processes, and their contribution to peer processes and early alcohol use, as hypothesised by the PPM. The PPM posits that early alcohol use among children tends to be motivated by snowball risk processes. The IYDS cohorts provide an opportunity to test the PPM proposition that for children as young as those in Grades 5 and 6, the main source of influence for alcohol use still predominantly comes from the family. For the above reasons, family risk factors were chosen from the IYDS as covariates to be investigated for their association with latent peer groupings and as covariates of transitions between latent subgroups in the youngest cohorts. These factors were *Family history of antisocial behaviour*, *Poor family management*, *Family conflict*, and *Parental attitudes favourable towards drug use*. The PPM also recognises the strong association between alcohol initiation and puberty and particularly among early maturers that they are more likely to initiate alcohol when they are exposed to high levels of other risk factors. Therefore, *Pubertal timing* was included as a covariate for analysis.

The PPM posits that for older adolescents who have started high school (the middle cohort) or who are established in school (the oldest cohorts), peer influence processes become more prominent as they invest more time and have more opportunities to interact with their peers in school. Aggregation of alcohol-using peers, which is hypothesised as part of the snowstorm risk processes by the PPM, was represented by a variable measuring the *Proportion of drinkers in the classroom*. Moreover, two variables in the school context were chosen to be tested as potential protective factors against snowstorm risk processes that may modify or reduce peer processes. These factors were *Involvement in clubs*, and *Opportunities for prosocial involvement at school*. Further, *Opportunities for prosocial involvement in the family* was chosen for testing as a protective factor against peer risk processes. *Gender* was also introduced into the models to control for gender differences. The wording of the items and original responses

measuring the covariates at baseline (i.e. Grades 5, 7, and 9) are shown in Appendix B.

2.2.2.2.1 *Covariates predicting Time 1 latent class membership and transition over time*

Covariates at Time 1 (i.e. Grades 5, 7 or 9) were selected according to the PPM. See Appendix B for the wording of the items for all covariates. All covariates were standardised to ease interpretation and comparison to other covariates and were modelled as continuous variables, except *Pubertal timing* and *Gender* (modelled as binary variables). When covariates are standardised, a one-unit change translates to a one-standard-deviation change for each covariate. The internal reliability of the scales for all continuous covariates (except *Proportion of drinkers in classroom* and *Involvement in clubs*) ranged from 0.49 to 0.84 and have been reported previously (Hemphill et al., 2011). Table 2.3 presents the proportion, mean, standard deviation and Cronbach's alpha of these covariates in each cohort by states.

Table 2.3
Proportion, mean, standard deviation, and Cronbach's alpha of covariates for each cohort by state.

	Victoria			Washington State		
	Grade 5	Grade 7	Grade 9	Grade 5	Grade 7	Grade 9
Pubertal timing						
0 On-time/late maturing (*N*)	726	774	806	668	697	730
1 Early maturing (*N* (%))	132 (15%)	150 (16%)	139 (14%)	116 (13%)	181 (19%)	176 (18%)
Cronbach's alpha of the	0.60 for male;	0.73 for male;	0.69 for male;	0.57 for male;	0.75 for male;	0.68 for male;
Pubertal Development Scale	0.61 for female	0.67 for female	0.53 for female	0.69 for female	0.63 for female	0.55 for female
Family history of antisocial behaviour						
Range	1 – 5	1 – 4.8	1 – 5	1 – 5	1 – 5	1 – 5
Mean (SD)	1.5 (0.5)	1.7 (0.7)	2.0 (0.8)	1.4 (0.6)	1.8 (0.9)	2.1 (1.0)
Cronbach's alpha	0.66	0.72	0.77	0.70	0.80	0.82
Poor family management						
Range	1 – 3.6	1 – 3.7	1 – 4	1 – 4	1 – 3.6	1 – 4
Mean (SD)	1.4 (0.4)	1.6 (0.5)	1.9 (0.5)	1.3 (0.3)	1.5 (0.5)	1.8 (0.5)
Cronbach's alpha	0.73	0.79	0.77	0.75	0.81	0.79
Family conflict						
Range	1 – 4	1 – 4	1 – 4	1 – 4	1 – 4	1 – 4
Mean (SD)	2.0 (0.8)	2.1 (0.8)	1.8 (0.5)	1.9 (0.8)	2.2 (0.8)	2.4 (0.7)
Cronbach's alpha	0.76	0.81	0.77	0.74	0.80	0.76
Involvement in clubs						
Range	n/a	3.2 – 8	2.6 – 7	n/a	2 – 6.3	1.5 – 6.2
Mean (SD)	n/a	4.6 (0.8)	4.3 (1.0)	n/a	3.8 (0.7)	4.2 (1.0)
Cronbach's alpha	n/a	n/a	n/a	n/a	n/a	n/a

Table 2.3 (continued)

	Victoria			Washington State		
	Grade 5	Grade 7	Grade 9	Grade 5	Grade 7	Grade 9
Parental attitudes favourable towards drug use						
Range	1 – 4	1 – 4	1 – 4	1 – 4	1 – 4	1 – 4
Mean (SD)	1.2 (0.4)	1.4 (0.5)	1.7 (0.6)	1.1 (0.3)	1.2 (0.4)	1.3 (0.5)
Cronbach's alpha	0.63	0.72	0.76	0.87	0.84	0.84
Proportion of drinkers in the classroom (%)						
Range	n/a	18.8 – 100	0 – 100	n/a	0 – 100	16 – 100
Mean (SD)	n/a	58.2 (14.3)	81.1 16.1)	n/a	37.9 14.9)	56.2 (13.0)
Cronbach's alpha	n/a	n/a	n/a	n/a	n/a	n/a
Opportunities for prosocial involvement at school						
Range	n/a	1 – 4	1.4 – 4	n/a	1.4 – 4	1.6 – 4
Mean (SD)	n/a	3.1(0.4)	2.9 (0.4)	n/a	3.1 (0.4)	3.0 (0.4)
Cronbach's alpha	n/a	0.57	0.60	n/a	0.49	0.56
Opportunities for prosocial involvement in the family						
Range	n/a	1 – 4	1 – 4	n/a	1 – 4	1 – 4
Mean (SD)	n/a	3.2 (0.7)	3.0 (0.7)	n/a	3.1 (0.7)	3.0 (0.7)
Cronbach's alpha	n/a	0.74	0.71	n/a	0.74	0.76

n/a = not applicable. SD = standard deviation

Pubertal timing was constructed by standardising each individual's score from the Pubertal Development Scale (PDS; Petersen, Crockett, Richards, & Boxer, 1988) within each one year age band, gender, and state (Ge, Brody, Conger, Simons, & Murry, 2002). Pubertal timing is the relative timing of an individual's physical maturation compared to that of their same-sex, same-age peers. The age-standardisation of PDS scores was designed to control for the age-pubertal status confound, identify pubertal timing and allow cross-gender comparisons (Ge, Natsuaki, Neiderhiser, & Reiss, 2007). With response options ranging from 1 "Has not yet started" to 4 "Seems completed", the PDS asked respondents of both genders to report on their body hair development, growth spurt, and skin changes. Boys were asked to report on their facial hair development and voice changes, while girls were asked to report on breast development and menarche. These five items were averaged within each gender to yield the PDS score. A variable was then generated with a mean of 0 and a standard deviation of 1 for both boys and girls by standardising the PDS scores within age bands. Higher scores indicated earlier maturation relative to their same-age and same-sex peers. Adolescents whose scores were one standard deviation above or below the sample mean were classified as early maturing or late maturing, respectively. Those with pubertal timing scores that fell within one standard deviation from the mean were classified as maturing on time. Previous studies have shown that early maturation among boys and girls has been associated with increased alcohol use and more substance-using peers (Biehl et al., 2007; Marklein, Negriff, & Dorn, 2009; Patton et al., 2004; Wichstrøm, 2001). Affiliation with alcohol-using peers during early adolescence may be part of the snowball risk processes and as hypothesised in the PPM, puberty plays a role in the association between snowball risk processes and early alcohol use. Therefore, late and on-time maturation were collapsed into one category and was coded as 0 while early maturation was coded as 1.

Family history of antisocial behaviour was measured by ten items, five of which asked respondents whether their siblings, if any, had ever drunk alcohol, used marijuana and tobacco, taken a weapon to school, and been suspended or

expelled from school. Response options were 1 "Yes", 2 "No", and 3 "I don't have any brothers or sisters". One item asked whether anyone in the respondents' family ever had a severe alcohol or drug problem. The response options were 1 "Yes" and 2 "No". The other 4 items asked respondents to report the number of adults they know personally who had gotten drunk, used marijuana and other illegal drugs, sold drugs, and done other things that could get them into trouble with the police in the past 12 months. Response options ranged from 1 "None" to 5 "5 or more adults". The first six items were recoded to a 5-point scale before summing with the other items to produce a total score with a common metric.

Poor family management was the mean of nine items rated on a scale ranging from 1 "YES!" (definitely yes) to 4 "NO!" (definitely no). Sample items included "My parents would know if I did not come home on time", "The rules in my family are clear", and "If you skipped school without your parents' permission would you get caught by your parents?".

Family conflict was the mean of three items rated on a scale ranging from 1 "YES!" (definitely yes) to 4 "NO!" (definitely no). Respondents were asked to indicate the degree to which they argue about the same things in their family over and over, people in their family have serious arguments, and people in their family often insult or yell at each other.

Parental attitudes favourable towards drug use was measured by 3 items in Grade 5 and 4 items in Grades 7 and 9 asking students how wrong their parents felt it would be for them to smoke cigarettes, drink beer or wine, liquor/spirits regularly (one item in Grade 5 and two items in Grades 7 and 9), and use marijuana. Response options ranged from 1 "Not wrong at all" to 4 "Very wrong".

Proportion of drinkers in the classroom was constructed by using the classroom survey context to estimate the proportion of the classroom respondents that used alcohol. Student survey respondents reported the number of occasions

they had had more than just a few sips of an alcoholic beverage in their lifetime. Response options ranged from 1 "Never" to 8 "40 or more times". Students were then categorised into two drinking statuses based on their lifetime alcohol use: Non-drinkers (never had any alcohol) and drinkers (had drunk alcohol on 1 or more occasion). The proportion of drinkers in each classroom was computed relative to each student's drinking status, i.e., the total number of drinkers (minus 1 if the student was a drinker) divided by the total number of students (excluding the student themselves) within the same classroom. For example, if there were four drinkers out of a class of five students, the proportion of drinkers would be 1 relative to the non-drinker and 0.75 relative to the drinkers.

Involvement in clubs was constructed by a single item asking students to indicate how many times in the past 12 months they had been involved in sports, clubs, organisations, or other activities at school. Response options ranged from 1 "Never" to 8 "40+ times". Students' individual scores were averaged in each classroom to generate the mean level of club activity participation per classroom.

Opportunities for prosocial involvement at school was the mean of five items rated on a scale ranging from 1 "YES!" (definitely yes) to 4 "NO!" (definitely no). Sample items included "Teachers ask me to work on special classroom projects", "There are lots of chances for students in my school to talk with a teacher one-on-one", and "I have lots of chances to be part of class discussions or activities".

Opportunities for prosocial involvement in the family was the sum of three items rated on a scale ranging from 1 "YES!" (definitely yes) to 4 "NO!" (definitely no). Students were asked to report the degree to which they could ask their parents for help if they had a personal problem, their parents give them lots of chances to do fun things with them, and their parents ask them what they think before most family decisions affecting them are made.

2.2.2.3 Items for measuring honesty among participants

Several items were used to assess whether students answered the survey honestly. Students in all grade levels were asked how honest they were when filling out the survey and whether they had ever taken a fake drug in their lifetime (5^{th} and 6^{th} graders) or in the past 30 days (students in Grade 7 to 10). In addition, students in Grades 7 to 10 were identified as dishonest if they had used illicit drugs on more than 120 occasions in the past 30 days. A single measure of honesty ("Yes" and "No") was calculated using these items. Students scored as dishonest were not included in data analyses.

2.2.3 Analytic strategy

Analysis steps were undertaken according to the study objectives. Objectives 1 and 2 (see Section 2.2) were analysed simultaneously due to the recommendation by Collins and Lanza (2010) that the basis for selecting LTA models is mainly an assessment of fit using data from all occasions of measurement. Two waves of data from three cohorts of participants of the IYDS were utilised. Analysis steps were repeated for each cohort and analyses were performed separately for each state. Results from multigroup LTA incorporating state as a grouping variable showed statistically significant *p*-values for all three cohorts indicating that measurement invariance cannot be established across state. Further examinations on the latent class structure revealed differences between states. Hence, analyses were done separately by state to ensure cultural differences are captured and reported.

2.2.3.1 Analysis step 1: Model identification

A LTA model is considered identified when the same solution of ML parameter estimates are produced using different sets of starting values (i.e., solution stability). The best solution is one that has the smallest log-likelihood

value among the solutions generated by using different starting values (Lanza & Collins, 2008). The higher the percent of times the ML solutions is identified across different random starting values, the higher the stability of the solutions. To ensure that the ML solutions were identified, solutions that were generated by at least ten percent of the starting values provided for estimation were reported in the results chapters (Lanza & Bray, 2010). Random start values were generated by providing a seed value in PROC LTA; 300 random sets of starting values were used for all LTA model estimations in the current study. Furthermore, item-response probabilities were constrained to be equal (also known as measurement invariance) over time when estimating LTA models for practical reasons. When item-response probabilities are identical over time, the nature and meaning of latent statuses remain constant over time. Thus any group differences observed in latent status prevalences are interpreted as quantitative differences. Assuming measurement invariance over time can decrease the number of parameters that needs to be estimated which helps to stabilise model estimation and improve identification. The derived transition matrix is also easier to interpret when the meaning of latent statuses remains identical across time (Collins & Lanza, 2010).

2.2.3.2 Analysis step 2: Assessing model fit and model selection

Several model fit information criteria were used to identify a best fit LTA model that best captured the heterogeneity in patterns of adolescent and peer drinking behaviour. The best fit model was selected by comparing information criteria among a series of models with different numbers of latent statuses (from two to six latent peer statuses). The likelihood-ratio G^2 fit statistics (Agresti, 1990), Akaike Information Criterion (AIC; Akaike, 1987), Bayesian Information Criterion (BIC; Schwarz, 1978), the solution stability, and the interpretability of the competing solutions were taken into account when selecting the best fitting model (Collins & Lanza, 2010). It is also useful to consider the principle of parsimony, which suggests that when two competing models can be interpreted in essentially the same way, the model with fewer latent statuses is preferred (Lanza & Collins, 2008). Measurement invariance of the chosen model was tested

empirically by comparing two statistically nested models: Model 1 where the item-response probabilities were freely estimated at both time points, with Model 2 where item-response probabilities were constrained to be equal across time. The difference of the G^2 of the two nested models was then compared to a chi-square (χ^2) table using the difference in degrees of freedom (*df*) between the two models to examine whether the underlying structure of alcohol use behaviour was the same across time.

2.2.3.2.1 *LTA model selection*

Fit statistics of competing models were compared to select a best fit LTA model. The degrees of freedom in most LTA models are large and large models suffer from sparseness in the observed data table. The distribution of G^2 values will not be well enough approximated by the χ^2 distribution for *p*-values to be accurate when data are sparse (Collins & Lanza, 2010). Therefore, selection of models relied mainly on AIC and BIC. A model with lower AIC and BIC values is preferred as lower values in these fit criteria indicate an optimal balance between model fit and parsimony (Lanza, Patrick, et al., 2010). It is also useful to consider latent class separation and the degree of homogeneity when assessing the interpretability of the competing solutions. High separation of latent classes occurs when each latent class is characterised by its own unique pattern of item-response probabilities so that a response pattern will be characteristic of one latent class only. Moreover, when one response pattern is highly characteristic of a latent class, with item-response probability close to 0 or 1, the latent class is considered to be highly homogenous (Collins & Lanza, 2010). A model displays a high degree in both aspects in latent classes that are conceptually appealing is preferred.

2.2.3.3 Analysis step 3: Incorporating covariates into LTA models

To test the significance of each covariate, a series of hypothesis tests were conducted using a likelihood ratio χ^2 test. In models with two or more covariates,

the null hypothesis is that the covariate of interest does not contribute significantly to prediction over and above the contribution of the other covariates in the model. There are two hypothesis tests for each covariate: (1) the covariate is a statistically significant predictor for latent status membership at Time 1; and (2) the covariate is a statistically significant predictor of transitions between latent statuses (Collins & Lanza, 2010). Each hypothesis was tested by comparing the fit of a model that includes all covariates except the covariate of interest, Model 1 that estimates ρ_1 parameters, with Model 2 that includes all covariates (including the covariate of interest) and estimates ρ_2 parameters. Negative two times the difference in log-likelihood ($-2(\ell_1 - \ell_2)$) is in theory distributed as a chi-square distribution with *df* = $\rho 2 - \rho 1$ (Collins & Lanza, 2010), enabling the significance of the model-fit contribution of each covariate to be calculated. Six predictors were incorporated to the final best fit LTA model in the youngest cohort, while ten predictors were tested in the middle and oldest cohorts.

Preparation of measures, including recoding of binary variables and covariates and standardisation of continuous covariates, were completed using STATA software for Windows, version 10 (StataCorp, 2007). All LTA models were fit using PROC LTA version 1.2.7 (Lanza, Lemmon, et al., 2010), a SAS procedure developed for SAS® version 9.2 for Windows[2]. Examples of PROC LTA syntax for specifying LTA models in the current study can be found in Appendix C. Missing data on the observed indicators are handled in this procedure and are assumed to be missing at random.

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Chapter Three: Results for the youngest cohort – Grades 5 and 6

This chapter contains results from the youngest cohort in which participants were first interviewed when they were in Grade 5 (10 to 11 years) and followed up again in Grade 6 (11 to 12 years). It begins with a description of general trends and the proportion endorsing each of the observed binary indicators. A series of competing models were run and their model fit statistics were presented for comparison. These findings are followed by a presentation of the best fit LTA model which includes the prevalences and characteristics of each latent status. The rationale for interpretation and labelling of latent statuses is detailed. Further, the probability of transitions between latent peer subgroups over time, and the risk factors identified for predicting Time 1 memberships and transitions over time are presented. Results from Victoria are presented first followed by results from Washington State. The chapter concludes with a summary of the findings both cross-sectionally and prospectively in each state.

Table 3.1 shows the observed sample size and proportion endorsing each binary indicator. In this young age group, a high percentage of children reported that they did not have any best friends who drank alcohol (85% in Victoria vs. 93% in Washington State); however, the percentage decreased in Grade 6 in both states (78% in Victoria vs. 85% Washington State). Over half of 5th graders in Victoria (51%) reported having tried alcohol in their lifetime, compared to a lower percentage of Washington children (21%). Recent alcohol use was also uncommon among children in Washington State; by Grade 6 only 8% and 12% reported having tried alcohol in the past 30 days and in the past year, respectively. In contrast in Victoria, 31% of 6th graders had already tried alcohol in the last 12 months and 25% of children consumed alcohol in the last 30 days prior to the survey. Thirty-six percent of Victorian children reported that they thought they would be seen as cool if they started drinking regularly in both Grades 5 and 6; which was double the proportion reporting on the same indicator by 6th graders in Washington State (18%). Furthermore, it was extremely rare for children to

report having been drunk in the past year and having accepted an alcoholic drink at a party in both states.

Table 3.1
Observed sample size and proportion endorsed of the eight binary observed indicators of self and peers drinking statuses for the youngest cohort by state.

	Grade 5		Grade 6	
Binary indicators	*N*	Proportion (%)	*N*	Proportion (%)
		Victoria		
No drinking friends	742	85	681	78
1 to 2 drinking friends	114	13	143	16
3 to 4 drinking friends	19	2	51	6
Drink if friend offered at party	34	4	67	8
Be seen as cool if drink regularly	310	36	308	36
Ever drunk	31	4	*	*
Drunk during the past year	*	*	32	4
Past 30 day alcohol use	*	*	215	25
Past year alcohol use	246	28	267	31
Lifetime alcohol use	444	51	*	*
		Washington State		
No drinking friends	826	93	755	85
1 to 2 drinking friends	58	7	104	12
3 to 4 drinking friends	5	1	30	3
Drink if friend offered at party	5	1	25	3
Be seen as cool if drink regularly	67	8	158	18
Ever drunk	8	0.01	*	*
Drunk during the past year	*	*	17	2
Past 30 day alcohol use	*	*	74	8
Past year alcohol use	66	7	108	12
Lifetime alcohol use	188	21	*	*

*Not used in respective wave.

3.1 Model selection among competing models

A series of LTA models with two to four latent statuses were run and it was expected that the number of latent statuses for this cohort would not exceed four based on examination of the observed data. Table 3.2 shows the model fit

information of fitting LTA models with two to four latent statuses by state. The AIC and BIC both declined through four latent statuses with their lowest values corresponding to the four-latent-status model in both states. However, upon examination of the profiles of both the three-latent-status model and four-latent-status model, the three-latent-status model was found to be conceptually more appealing and was more parsimonious hence the three-latent-status model was chosen for each state.

Table 3.2
Model fit information of fitting LTA models with two to four latent statuses for the youngest cohort by state.

Number of latent statuses	G^2*	*df*	AIC	BIC	Log-likelihood
			Victoria		
2	2466.41	65516	2504.41	2595.12	-4897.71
3	**1679.85**	**65503**	**1743.85**	**1896.63**	**-4504.43**
4	1250.64	65488	1387.05	1611.44	-4311.03
			Washington State		
2	1322.7	65516	1360.7	1451.71	-2883.32
3	**900.49**	**65503**	**964.49**	**1117.78**	**-2672.22**
4	667.89	65488	761.89	987.03	-2555.92

**p*-values not reported because the degrees of freedom are too large.

Note. Bold entries reflect selected model.

The hypothesis test of measurement invariance was conducted for the three-latent status models. For Victoria, the model with item-response probabilities constrained to be equal across time (G^2 = 1679.85 with 65503 *df*) was compared to one with item-response probabilities estimated freely (G^2 = 1587.90 with 65479 *df*). The difference G^2 of 91.95 was compared to a χ^2 table with *df* equal to 40 yielding a *p*-value < 0.001. For Washington State, the model with item-response probabilities constrained to be equal across time (G^2 = 900.48 with 65503 *df*) was compared to one with item-response probabilities estimated freely (G^2 = 778.67 with 65479 *df*). The difference G^2 of 121.82 was compared to a χ^2 table with *df* equal to 40 yielding a *p*-value < 0.001. These non-significance

p-values indicate that the underlying structures of drinking behaviour differ across time in both states. Upon close inspection of the item-response probabilities of the freely estimated model in each state, the probabilities in Grade 6 were similar to those in Grade 5 and different latent status labels were not required for the latent structure in Grade 6. Therefore, item-response probabilities were constrained to be equal across time in the final LTA model in both states.

3.2 Labelling latent status and interpretation

Labelling a latent status can be cumbersome; depending on the indicators there are many potential combinations that may suggest a label for a latent status. Because the main interest in the empirical study was adolescents and their close friends' alcohol use behaviours and the transitions between latent subgroups, naming of latent status was based on the combination of adolescents' and their close friends' drinking patterns. Drinking patterns were defined according to item-response probabilities with a cut-off point of 0.5. Individuals were labelled as "non-drinkers" if the probabilities of endorsing the indicators "lifetime alcohol use", "past year alcohol use", and "past 30 days alcohol use" were lower than 0.5. Those who were labelled as "experimenters" had a higher than 50% chance of answering "yes" to the items "lifetime alcohol use" and "past year alcohol use", but less than 50% chance of saying "yes" to the item "past 30 days use". For individuals to be assigned as "drinkers", they had to have a high chance of endorsing the item "past 30 days alcohol use". To be classified as bingers, they had to have a high probability of over 0.5 of reporting "yes" to having binge drank in the past two weeks. Moreover, peers were labelled "non-drinking friends" if the probability of having no best friends who had tried alcohol was over 0.5; "2 drinking friends" if adolescents had a higher than 50% chance of having one or two best friends who drank; and "4 drinking friends" if over 50% answered "yes" to had had three or four of their best friends who drank. Therefore, a latent status characterised with high item-response probabilities in the indicators "no drinking friends", "past year use", and "lifetime alcohol use" was labelled "experimenters

with non-drinking friends". Other latent statuses were labelled in a similar fashion.

Note that different indicators of alcohol use were used in Time 1 and 2 in each cohort for both states. In Grade 5, drinking statuses were informed by items "past year alcohol use" and "lifetime alcohol use" while in Grade 6 "past 30 days alcohol use" was used instead of "lifetime alcohol use". In Grades 7 and 9, drinking was measured by items "past 30 days alcohol used" and "lifetime alcohol use" while in Grades 8 and 10 "past year alcohol use" was used instead of "lifetime alcohol use". Thus latent statuses were labelled accordingly to reflect these different alcohol use indicators.

3.3 Peer group patterns and characteristics

3.3.1 Final LTA model for Victoria

A three-latent-status model was found to best capture the heterogeneity of peer drinking groups in Victoria. Table 3.3 presents the full sets of parameter estimates of the three-status LTA model for Victoria. The top section of the table shows the item-response probabilities for each latent status. To facilitate interpretation, item-response probabilities that are greater than 0.5 are highlighted in bold. Because item-response probabilities were constrained to be equal across time, only one set of item-response probabilities is shown.

Table 3.3
Three-Latent-Status Model of self-reported drinking statuses of adolescents and their peers in Grades 5 and 6 in Victoria (N = 875).

	Latent Status		
	Non-drinkers + non-drinking friends	Experimenters + non-drinking friends (Drinkers + non-drinking friends in G6)[1]	Experimenters + 2 drinking friends (Drinkers + 2 drinking friends in G6)[1]
*Item-response probabilities of a "Yes" response (G5 & G6)**			
No drinking friends	**1.0000**[†]	**1.0000**	0.0000
1 to 2 drinking friends	0.0000	0.0000	**0.7859**
3 to 4 drinking friends	0.0000	0.0000	0.2141
Drink if friend offered at party	0.0109	0.0513	0.2025
Be seen as cool if drink regularly	0.2781	0.3721	**0.5542**
Ever drunk (Drunk during the past year in G6)[2]	0.0029	0.0577	0.1217
Past year alcohol use (past 30 days alcohol use in G6)[2]	0.0150	**0.5683**	**0.5229**
Lifetime alcohol use (Past year alcohol use in G6)[2]	0.0233	**0.9825**	**0.6483**
Prevalence of latent status			
Grade 5 (G5)	47%	38%	15%
Grade 6 (G6)	61%	17%	22%
Probability of transitioning to ...	*...Grade 6 latent status*		
Conditional on Grade 5 latent status			
Non-drinkers + non-drinking friends	**0.78**[‡]	0.08	0.14
Experimenters + non-drinking friends	0.50[a]	**0.26**	0.23[b]
Experimenters + 2 drinking friends	0.32	0.23	**0.45**

ℓ = -4504.43. [1]Grade 6 Latent status labelled differently according to the alcohol use indictors used in Grade 6. [2]Alcohol use indicators used in Grade 6.
*Item-response probabilities constrained to be equal across times. [†]Item-response probabilities > 0.5 in bold to facilitate interpretation.
[‡]Diagonal transition probabilities in bold to facilitate interpretation. [a]Reverse peer influence transition. [b]Peer selection transition.

The first latent status was characterised by a high probability of having no best friends who drank (probability = 1.00) and a low probability of having tried alcohol in the past year in Grade 5 and in the past 30 days in Grade 6 (probability = 0.02). Individuals in this latent status also had a low probability of having used alcohol in their lifetime in Grade 5 and in the past year in Grade 6 (probability = 0.02). This latent status was labelled "non-drinkers with non-drinking friends". Individuals who were assigned to the second latent status had a high probability of having non-drinking friends (probability = 1.00) and having used alcohol in their lifetime in Grade 5 and in the past year in Grade 6 (probability = 0.98). This group of individuals also had a 0.57 probability of answering "yes" to the items "past year alcohol use" in Grade 5 and "past 30 days alcohol use" one year later in Grade 6. Therefore, this latent status was labelled "experimenters with non-drinking friends" in Grade 5 and "drinkers with non-drinking friends" in Grade 6. Compared to the second latent status, individuals in the third latent status also reported having tried alcohol during the past year in Grade 5 and in the past 30 days in Grade 6 (probability = 0.52). Additionally they had a high probability of having tried alcohol in their lifetime in Grade 5 and in the past year in Grade 6 (probability = 0.65). However, this group of individuals had a high probability of having one to two drinking friends (probability = 0.79). Thus, this latent subgroup was labelled "experimenters with 2 drinking friends" in Grade 5 and "drinkers with 2 drinking friends" in Grade 6.

The prevalence of each latent status is shown in the middle rows of Table 3.3. The most prevalent latent status was the "non-drinkers with non-drinking friends" latent status in Grade 5 (prevalence = 0.47) and one year later in Grade 6 (0.61). There was a substantial proportion of 5th graders who had started using alcohol in the absence of drinking peers (38%) in the "experimenters with non-drinking friends" latent subgroup. Although the proportion in this latent subgroup dropped to 17% one year later, there was an increase in the drinking level as well as in the proportion of experimenters who had one or two drinking friends from Grade 5 (15%) to Grade 6 (22%). The final rows in Table 3.3 present Grade 5 to Grade 6 transition probabilities and are discussed in later sections below.

3.3.2 Final LTA model for Washington State

A three-latent-status model also emerged as the best fit to describe peer groupings in Washington State. Table 3.4 shows the probability estimates for the best fit model. According to the item-response probabilities presented in the top rows of the table, the first latent status was characterised by an almost certain probability of 1.00 of having no drinking friends and a very low probability of trying alcohol in their lifetime in Grade 5 and in the past year in Grade 6 (probability = 0.02), and in the past year in Grade 5 and in the past 30 days in Grade 6 (probability = 0.002). This latent peer subgroup was labelled "non-drinkers with non-drinking friends". Unlike their Victorian counterparts, there was one more latent status that consisted of mainly non-drinkers but this group of individuals had a high probability of having one to two drinking friends (probability = 0.82). Therefore, this second latent status was labelled "non-drinkers with 2 drinking friends". The third latent status, similar to the Victorian sample, was also named "experimenters with non-drinking friends" because individuals who were categorised in this latent subgroup were almost certain to have no close friends who drank (probability = 1.00) and had a high probability of having tried alcohol in their lifetime in Grade 5 and in the past year in Grade 6 (probability = 0.90).

Table 3.4
Three-Latent-Status Model of self-reported drinking statuses of students and their peers in Grades 5 and 6 in Washington State (N = 889).

	Latent Status		
	Non-drinkers + non-drinking friends	Non-drinkers + 2 drinking friends	Experimenters + non-drinking friends
*Item-response probabilities of a "Yes" response (G5 & G6)**			
No drinking friends	**1.0000**[†]	0.0000	**1.0000**
1 to 2 drinking friends	0.0000	**0.8223**	0.0000
3 to 4 drinking friends	0.0000	0.1777	0.0000
Drink if friend offered at party	0.0007	0.1218	0.0236
Be seen as cool if drink regularly	0.0893	0.3350	0.1795
Ever drunk (Drunk during the past year in G6)[1]	0.0010	0.0714	0.0450
Past year alcohol use (past 30 days alcohol use in G6)[1]	0.0018	0.2245	0.4363
Lifetime alcohol use (Past year alcohol use in G6)[1]	0.0218	0.3706	**0.8972**
Prevalence of latent status			
Grade 5 (G5)	76%	7%	17%
Grade 6 (G6)	77%	15%	8%
Probability of transitioning to ...	*...Grade 6 latent status*		
Conditional on Grade 5 latent status			
Non-drinkers + non-drinking friends	**0.85**[‡]	0.11	0.04
Non-drinkers + 2 drinking friends	0.53	**0.38**	0.09
Experimenters + non-drinking friends	0.52[a]	0.24	**0.24**

ℓ = -2672.23. *Item-response probabilities constrained to be equal across times. [†]Item-response probabilities > 0.5 in bold to facilitate interpretation.
[1]Alcohol use indicators used in Grade 6. [‡]Diagonal transition probabilities in bold to facilitate interpretation. [a]Reverse peer influence transition.

According to the middle rows of Table 3.4, the majority of 5th and 6th graders in Washington State were classified as non-drinkers who had no drinking close friends and the proportion was stable over the course of one year (proportion = 0.76 and 0.77 in Grades 5 and 6 respectively). The next most prevalent latent status was the "experimenters with no-drinking friends" latent status (17% in Grade 5) and there was a decrease to 8% in Grade 6. The least prevalent latent status was the "non-drinkers with 2 drinking friends" latent status (7% in Grade 5 increasing to 15% by Grade 6).

3.3.3 Similarities and differences between states

One similar latent status was identified in both states. The "non-drinkers with non-drinking friends" latent status was the most prevalent latent peer subgroup in both states in Grade 6 (61% in Victoria and 77% in Washington State). The proportion of 5th and 6th graders in this latent status were higher in Washington State compared to the same grade-levels in Victoria. The "experimenters with non-drinking friends" latent status was identified in Grade 5 for both states, but was more common in Victoria (38%) compared to Washington State (17%). Furthermore, there was one latent status group difference between the states. In Washington State one more latent status containing non-drinkers was identified ("non-drinkers with 2 drinking friends") whereas in Victoria an additional experimenter latent status of was identified ("experimenters with 2 drinking friends"). The data showed that experimenters in Victoria compared to Washington State had a greater perception that using alcohol would be popular with peers. Victorian 5th graders in the "experimenters with 2 drinking friends" latent status and 6th graders in the "drinkers with 2 drinking friends" latent status had a 0.55 probability of reporting that they would be seen as cool if they started drinking regularly, whereas in Washington State the item-probability for the same indicator was lower (0.18) amongst Grades 5 and 6 experimenters. At this young age, the probability for 5th and 6th graders, in both states, to report accepting

alcoholic drinks offered by friends at parties and getting drunk at both time points were very low in each state.

3.4 Movements between latent peer statuses over time

Transitions or movements between latent statuses are described by a matrix of transition probabilities which is arranged with rows corresponding to Time 1 latent statuses and columns representing latent statuses at Time 2. Transition probability matrices of the final LTA models in Victoria and Washington State are shown in the bottom rows of Tables 3.3 and 3.4 respectively. The diagonal elements of the transition matrix represent the probability of being in the same latent status at Time 2 conditional on the latent status at the previous time point. The off diagonal elements of the matrix represent the probability of transitioning to another latent status at Time 2 conditional on Time 1 latent status. To facilitate interpretation, transition probabilities in diagonal in the tables were highlighted in bold.

According to Table 3.3, in Victoria, 5th graders in the "non-drinkers with non-drinking friends" latent status displayed high stability (probability = 0.78) of remaining in the same latent status in Grade 6. Among these non-drinkers in Grade 5 who made transitions, they most likely transitioned to becoming experimenters who had one or two drinking friends (probability = 0.14) one year later. Moreover, for those who started as experimenters and had no drinking best friends in Grade 5, they were most likely to revert to being non-drinkers with no best friends who drank in Grade 6 (probability = 0.50). This transition was regarded as compatible with peer influence to reverse from experimenting to non-drinking (reverse peer influence). In addition, this group of experimenters in Grade 5 had a 0.26 probability of escalating their drinking level to becoming current drinkers and a 0.23 probability of acquiring one or two drinking close friends (peer selection process) one year later. For the other latent subgroup of

experimenters who had one or two drinking friends in Grade 5, the probability of becoming current drinkers one year later was 0.45. If they did engage in a transition, they were most likely to revert to being non-drinkers who had no drinking friends in Grade 6 (probability = 0.32).

In Washington State, according to the transition matrix in the bottom rows of Table 3.4, 5th graders who were classified in the "non-drinkers with non-drinking friends" latent status also displayed high stability in staying in the same latent status one year later (0.85 probability). Among these non-drinkers in Grade 5 who made transitions, they were most likely to transition to having one or two drinking friends but remaining themselves non-drinkers in Grade 6 (probability = 0.11). For non-drinkers who had one or two best friends who had tried alcohol in Grade 5, they had a 0.38 probability of remaining in the same latent status one year later. These individuals also had a 0.53 probability of reverting to being non-drinkers who had no drinking peers in Grade 6, a transition that runs in the opposite direction to peer influence expectations. A transition compatible with reverse peer influence was evident in the latent subgroup of experimenters who had non-drinking close friends in Grade 5; who had a 0.52 probability of transitioning to non-drinking one year later in Grade 6.

A comparison of transitions in each state revealed some differences. First, a higher proportion of sample displayed stability in Washington State. This was most evident in the high proportions remaining non-drinkers with non-drinking friends over the one-year period. In Victoria the proportion in this latent subgroup in Grade 5 was 0.47 and they had a 0.78 probability of remaining stable in Grade 6, hence 37% (0.367 = 0.47 x 0.78) of the Victorian sample were in this category from Grade 5 to 6. In Washington State a higher proportion (65%; 0.646 = 0.76 x 0.85) were in this stable category. Additional forms of stability (stable non-drinkers with 2 drinking friends and stable experimenters) in Washington State were evident for 7%, hence in total 71% (64.6% + 6.7%) of the sample were stable. Second, in both states transitions that were congruent with reverse peer influence were evident applying to 19% in Victoria but only 9% in Washington

State. Third, the proportion in Victoria that were either already alcohol experimenters in Grade 5 or were non-users in Grade 5 that transitioned into being current drinkers by Grade 6 (10% = 0.47 x (0.08+0.14)) is higher compared to their counterparts in Washington State. One transition that was congruent with peer selection was evident only in Victoria and applied to 3% of the sample.

3.5 Effect of covariates

Table 3.5 shows the hypothesis tests associated with each Grade 5 snowball risk factor predicting Grade 5 latent status membership in each state. The effect of four covariates reached statistical significance in both states. There covariates were: *Gender* (Victoria: $p < 0.001$; Washington State: $p = 0.011$), *Family history of antisocial behaviour* ($p < 0.001$ for both states), *Family conflict* (Victoria: $p = 0.001$; Washington State: $p = 0.008$), and *Parental attitudes favourable towards drug use* (Victoria: $p < 0.001$; Washington State: $p = 0.001$). In addition, *Poor family management* ($p < 0.001$) and *Pubertal timing* ($p = 0.012$) were identified as statistically significant predictors of Grade 5 latent status membership for Victoria and Washington State, respectively, when all other covariates were included in the final LTA model.

For predicting transitions between latent peer statuses over time, Table 3.6 presents the results of the hypothesis tests for each of the snowball risk factors predicting transitions between latent statuses by states. Three covariates were found to be statistically significant predictors of transitions between latent statuses over time for both states, namely, *Pubertal timing* ($p < 0.001$ for both states), *Family history of antisocial behaviour* ($p < 0.001$ for both states), and *Family conflict* (Victoria: $p < 0.001$; Washington State: $p = 0.001$) when all other covariates were included in the final LTA model.

Table 3.5
Hypothesis tests of snowball risk factors in Grade 5 predicting Grade 5 latent status membership by state.

Grade 5 covariate	ℓ Removing Covariate (ℓ_1)	Likelihood-Ratio Statistic*	*df*	*p*-value
		Victoria		
Gender	-4225.29	26.28	2	**<0.001**
Pubertal timing	-4213.18	2.08	2	0.354
Family history of antisocial behaviour	-4238.14	51.99	2	**<0.001**
Poor family management	-4221.21	18.13	2	**<0.001**
Family conflict	-4218.93	13.58	2	**0.001**
Parental attitudes favourable towards drug use	-4227.19	30.08	2	**<0.001**
		Washington State		
Gender	-2227.36	8.94	2	**0.011**
Early pubertal timing	-2227.29	8.81	2	**0.012**
Family history of antisocial behaviour	-2243.92	42.04	2	**<0.001**
Poor family management	-2223.22	0.67	2	0.716
Family conflict	-2227.69	9.58	2	**0.008**
Parental attitudes favourable towards drug use	-2229.51	13.24	2	**0.001**

*Calculated using $-2(\ell_1 - \ell_2)$.

Victoria $\ell_2 = -4212.15$. Washington State $\ell_2 = -2222.89$.

Note. All covariates entered simultaneously as predictors of Grade 5 latent status membership.

p-values of statistically significant covariates are highlighted in bold.

Table 3.6
Hypothesis tests of snowball risk factors in Grade 5 as predictors of transitions between latent peer statuses in Grades 5 and 6 by state.

Grade 5 covariates	ℓ Removing Covariate (ℓ_1)	Likelihood-ratio Statistic*	*df*	*p*-value
		Victoria		
Gender	-4307.12	7.70	6	0.261
Pubertal timing	-4401.08	195.62	6	**<0.001**
Family history of antisocial behaviour	-4376.37	146.20	6	**<0.001**
Poor family management	-4305.26	3.98	6	0.679
Parental attitudes favourable towards drug use	-4307.89	9.24	6	0.161
Family conflict	-4315.17	23.80	6	**<0.001**
		Washington State		
Gender	-2270.39	1.58	6	0.954
Pubertal timing	-2531.46	523.72	6	**<0.001**
Family history of antisocial behaviour	-2334.46	129.72	6	**<0.001**
Poor family management	-2269.70	0.20	6	0.999
Parental attitudes favourable towards drug use	-2271.23	3.26	6	0.776
Family conflict	-2280.81	22.42	6	**0.001**

*Calculated using $-2(\ell_1 - \ell_2)$.

Victoria $\ell_2 = -4303.27$. Washington State $\ell_2 = -2269.60$.

Note. All covariates entered simultaneously as predictors of transitions between Grade 5 and Grade 6 latent status memberships.

p-values of statistically significant covariates are highlighted in bold.

3.5.1 Predicting Grade 5 latent status membership

Table 3.7 presents the effect of each Grade 5 covariate predicting Grade 5 latent status membership in regression coefficients and odds ratios (*OR*), using the "non-drinkers with non-drinking friends" latent status as the reference latent status

in both states. The regression coefficients associated with prediction of Time 1 latent status membership are interpreted as the change in odds of membership in latent status at Time 1, relative to the reference latent status at Time 1, associated with a one-unit increase in the covariate (Collins & Lanza, 2010). All covariates were entered simultaneously as predictors of Grade 5 latent status membership. Odds ratios were reported due to easier interpretation. As continuous covariates were standardised, the odds ratio can be interpreted as the contribution to being in a particular latent status relative to the reference latent status due to a one standard deviation change in the predictor. An odds ratio of 1.0 suggested that individuals at all levels of the covariate had equal odds of being in a particular latent status relative to the reference latent status. For binary covariates, an odds ratio greater than 1.0 suggested that individuals having a value of 1 on the covariate had increased odds of membership in a particular latent status relative to the reference latent status, compared to individuals with a value of 0 on the covariate. Likewise, an odds ratio less than 1.0 suggested that individuals having a value of 1 on the covariate had decreased odds of membership in a particular latent status relative to the reference latent status, compared to individuals with a value of 0 on the covariate (Lanza, Patrick, et al., 2010).

Table 3.7
Regression coefficients and odds ratios of Grade 5 snowball risk factors predicting Grade 5 latent status membership by state.

	Grade 5 Latent Status					
	Victoria			Washington State		
	Non-drinkers + non-drinking friends	Experimenters + non-drinking friends	Experimenters + 2 drinking friends	Non-drinkers + non-drinking friends	Non-drinkers + 2 drinking friends	Experimenters + non-drinking friends
Intercept						
β_0's	ref[1]	0.34	-0.74	ref[1]	-2.30	-1.15
Odds	ref	1.41	0.48	ref	0.10	0.32
Gender (female=1)						
β_1's	ref	-0.70	-1.21	ref	-0.30	-0.77
Odds Ratios	ref	0.50	0.30	ref	0.74	0.46
Pubertal timing (early maturer =1)						
β_2's	ref	ns	ns	ref	0.84	0.84
Odds Ratios	ref	ns	ns	ref	2.32	2.31
Family history of antisocial behaviour						
β_3's	ref	0.86	0.95	ref	0.74	0.50
Odds Ratios	ref	2.35	2.58	ref	2.10	1.65
Poor family management						
β_4's	ref	0.07	0.45	ref	ns	ns
Odds Ratios	ref	1.07	1.57	ref	ns	ns
Family conflict						
β_5's	ref	0.22	0.43	ref	0.23	0.42
Odds Ratios	ref	1.24	1.53	ref	1.26	1.52

Table 3.7 (continued)

	Grade 5 Latent Status					
	Victoria			Washington State		
	Non-drinkers + non-drinking friends	Experimenters + non-drinking friends	Experimenters + 2 drinking friends	Non-drinkers + non-drinking friends	Non-drinkers + 2 drinking friends	Experimenters + non-drinking friends
Parental attitudes favourable towards drug use						
β_6's	ref	1.13	1.00	ref	0.88	1.12
Odds Ratios	ref	3.10	2.73	ref	2.41	3.07

Victoria ℓ = -4212.15. Washington State ℓ = -2222.89.

Note. All Grade 5 covariates entered simultaneously as predictors of Grade 5 latent status membership.

[1]The "non-drinkers with non-drinking friends" latent status served as the reference category in multinomial logistic regressions.

ns = not statistically significant.

3.5.1.1 Effect of covariates in Victoria

According to Table 3.7, females were less likely to have experimented with alcohol with or without the presence of drinking friends. The odds for female were 50% and 70% less likely (*OR* = 0.50 and 0.30 respectively) to be in the "experimenters with non-drinking friends" and "experimenters with 2 drinking friends" latent statuses, respectively, compared to the "non-drinkers with non-drinking" latent status and to males. Moreover, higher levels of *Family history of antisocial behaviour*, *Poor family management*, *Family conflict*, and *Parental attitudes favourable towards drug use*, were associated with an increase in the odds of being in the "experimenters with non-drinking friends" and the "experimenters with 2 drinking friends" latent statuses relative to the reference latent status. The odds ratios of the effect of these snowball risk factors predicting the latent status membership of being experimenters without drinking close friends ranged from 1.07 (*Poor family management*) to 3.10 (*Parental attitudes favourable towards drug use*). In addition, the odds ratio of snowball risk factors predicting the "experimenters with 2 drinking friends" latent status membership ranged from 1.53 (*Family Conflict*) to 2.73 (*Parental attitudes favourable towards drug use*).

3.5.1.2 Effect of covariates in Washington State

The overall effects were similar to Victoria. Being female was again protective against being in the riskier latent statuses relative to the "non-drinkers with non-drinking friends" latent status as shown in Table 3.7. Females were less likely to have had drinking friends (*OR* = 0.74) or to have experimented with alcohol in the absence of drinking friends (*OR* = 0.46) in comparison to the reference latent status and to males. *Pubertal timing* was associated with a higher odds of being in the riskier latent subgroups; early maturers were about 2.3 times more likely than late/on-time maturers to be non-drinkers with one or two drinking friends, or to have tried alcohol without any close friends who drank in Grade 5. For standardised risk factors, a one standard deviation increase in

Family history of antisocial behaviour, *Family conflict*, and *Parental attitudes favourable towards drug use* was associated with an increase odds of being in the "non-drinkers with 2 drinking friends" and the "experimenters with non-drinking friends" latent statuses relative to the reference latent status. The odds ratios of these snowball risk factors predicting the latent status membership of being experimenters without any drinking close friends ranged from 1.26 (*Family conflict*) to 2.41 (*Parental attitudes favourable towards drug use*). Moreover, the odds ratios of risk factors predicting the membership in the "experimenters with non-drinking friends" latent status ranged from 1.52 (*Family conflict*) to 3.07 (*Parental attitudes favourable towards drug use*).

3.5.2 Predicting transitions over time

Table 3.8 and 3.9 present the odds ratios of the effect of the statistically significant snowball risk factors predicting transitions from Grade 5 to 6 latent status memberships for Victoria and Washington State respectively. All covariates were entered simultaneously as predictors of the transitions from Grades 5 to 6. The regression coefficients associated with prediction of latent status transitions from Time 1 latent status to Time 2 latent status are interpreted as the change in odds of transitioning to latent status at Time 2 in relation to the Time 2 reference latent status, conditional on the membership in latent status at Time 1, associated with a one-unit increase in the predictor (Collins & Lanza, 2010). The effects of covariates are reported in odds ratios for easier interpretation, however, confidence intervals for individual odds ratios are not yet available in PROC LTA. The diagonal elements of the transition matrices served as the reference category in the multinomial logistic regression for each row.

Table 3.8
Odds ratios of Grade 5 snowball risk factors predicting transitions between latent peer statuses in Grades 5 and 6 in Victoria.

	Grade 6 Latent Status		
	Non-drinkers + non-drinking friends	Drinkers + non-drinking friends	Drinkers + 2 drinking friends
Effect of Pubertal timing on probability of transitioning to... Conditional on Grade 5 latent status	*...Grade 6 latent status*		
Non-drinkers + non-drinking friends	ref[1]	1.52	1.46
Experimenters + non-drinking friends	0.62[a]	ref[2]	1.00[b]
Experimenters + 2 drinking friends	0.60	0.64	ref[3]
Effect of Family history of antisocial behaviour on probability of transitioning to... Conditional on Grade 5 latent status	*... Grade 6 latent status*		
Non-drinkers + non-drinking friends	ref	0.64	1.82
Experimenters + non-drinking friends	0.95[a]	ref	1.16[b]
Experimenters + 2 drinking friends	0.65	0.94	ref
Effect of Family conflict on probability of transitioning to... Conditional on Grade 5 latent status	*... Grade 6 latent status*		
Non-drinkers + non-drinking friends	ref	1.08	0.98
Experimenters + non-drinking friends	1.05[a]	ref	1.09[b]
Experimenters + 2 drinking friends	0.98	0.85	ref

ℓ = -4030.27. [a]Reverse peer influence transitions. [b]Peer selection transitions.
Note. All Grade 5 covariates entered simultaneously as predictors of Grade 5 to Grade 6 transitions. [1]Diagonal element of the transition matrix served as the reference category. [2]The reference category of the multinomial logistic regression analyses for this row was experimenters with non-drinking peers who escalated to being current drinkers with non-drinking peers. [3]The reference category of the multinomial logistic regression analyses for this row was experimenters with 2 drinking peers who escalated to being current drinkers with 2 drinking peers.

All odds ratios are interpreted as the effect of the covariate on the odds of transitioning from a latent status at Time 1 to another latent status at Time 2 relative to being in the same latent status at Time 2. For continuous covariates, an odds ratio of 1.0 suggested that individuals at all levels of the covariate had equal odds of transitioning to a particular latent status in Time 2 in relation to those individuals who did not make any transitions. For binary covariates, an odds ratio greater than 1.0 suggested that individuals having a value of 1 on the covariate had an increased odds of transitioning to a particular latent status at Time 2 relative to the reference latent status, compared to individuals with a value of 0 on the covariate, conditional on their Time 1 latent status membership. Similarly, an odds ratio less than 1.0 suggested that individuals having a value of 1 on the covariate had a decreased odds of transitioning to a particular Time 2 latent status relative to the reference latent status, compare to individuals with a value of 0 on the covariate, conditional on their Time 1 latent status membership.

It is noteworthy to mention that the effect of these statistically significant covariates on transitions controlled for the latent peer status at the previous time point because the multinominal logistic regression of each row of the transition matrices is conditional on Time 1 latent peer status. Since the main interest is the transitions congruent with peer processes, the presentation of results is focused on these transitions.

3.5.2.1 Effect of covariates on transitions over time in Victoria

Table 3.8 presents the effect of *Pubertal timing*, *Family history of antisocial behaviour*, and *Family conflict*, on transitions between latent statuses over the one-year period in Victoria. Note that due to the different alcohol used indicators utilised at the two time points, the reference category for the multinomial logistic regression for the row of the "experimenters with non-drinking friends" latent status in Grade 5 was those who escalated to current drinkers who had non-drinking peers one year later. Similarly, the reference category for the multinomial logistic regression of the row for the "experimenters

with 2 drinking friends" latent status in Grade 5 was those who escalated to current drinkers who had one or two drinking peers one year later.

3.5.2.1.1 ***Pubertal timing***

Among non-drinkers who did not have any drinking best friends in Grade 5, early maturers were more likely to transition to becoming drinkers with non-drinking friends (*OR* = 1.52), or drinkers with one or two drinking friends (*OR* = 1.46), relative to the "non-drinkers with non-drinking friends" latent status in Grade 6 and the late/on-time maturers. As for the moderating effect of *Pubertal timing* on peer selection processes, being early maturers or late/on-time maturers had equal odds of becoming drinkers with one or two drinking friends one year later (*OR* = 1.00). A reverse peer influence process was evident among 5th graders who were in the "experimenters with non-drinking friends" latent status. Among these experimenters who made transitions, it was less likely for early maturers to have been in the reverse peer influence transition in Grade 6 compared to late/on-time developers (*OR* = 0.62). Early maturers in Grade 5 classified as experimenters with one or two drinking friends were also less likely to revert to being non-drinkers one year later compared to their late/on-time maturing counterparts (*OR* = 0.60).

3.5.2.1.2 ***Family history of antisocial behaviour***

Among non-drinkers who had no drinking close friends in Grade 5, a one standard deviation increase in *Family history of antisocial behaviour* was associated with an 82% increase in the odds of transitioning to being in the "drinkers with two drinking friends" latent status, in relation to those individuals who remained in the same latent status in Grade 6 (*OR* = 1.82). However, this risk factor reduced the likelihood that these non-drinkers would transition to drinking on their own in the absence of any close friends who drank one year later (*OR* = 0.64). The moderating effect on peer selection transitions was evident in

the latent peer subgroup of experimenters who did not have any drinking best friends in Grade 5; a one standard deviation increase in the risk factor raised the odds of transitioning to being drinkers who had one or two drinking peers one year later by 16% (*OR* = 1.16). Moreover, among this same latent subgroup of experimenters in Grade 5, there was a small decrease in the odds of reverting to being non-drinkers due to the exposure of non-drinking friends (*OR* = 0.95; reverse peer influence process) one year later. In addition, this risk factor reduced the odds that the latent subgroup of experimenters who already had one or two close friends who drank in Grade 5, would transition to being in the "non-drinkers with non-drinking friends" latent status in Grade 6 (*OR* = 0.65).

3.5.2.1.3 ***Family conflict***

Among 5th graders who were non-drinkers and had no drinking close friends, they were at slightly increased odds of 8% (*OR* = 1.08) of starting using alcohol on their own if exposed to a one standard deviation increase in *Family conflict* compared to those who stayed in the same latent status in Grade 6. The effect of *Family conflict* on peer selection and reverse peer influence processes was evident in the "experimenters with non-drinking friends" latent status in Grade 5. Among this latent subgroup of experimenters, a one standard deviation increase in the risk factor raised the odds by 9% of transitioning to becoming a drinker with one or two drinking friends (peer selection) and increased the odds of reverting to being non-drinkers who had non-drinking best friends by 5% (reverse peer influence) one year later. For another latent subgroup of experimenters who had drinking best friends in Grade 5, a one-unit increase in the predictor was associated with a 15% decreased odds in having non-drinking friends but escalated to being current drinkers one year later (*OR* = 0.85).

3.5.2.2 Effect of covariates on transitions over time in Washington State

In overview, risk factors had generally similar effects in Washington State compared to Victoria in influencing developmental transitions to either initiating alcohol use or increasing associations with alcohol-using peers. In common with the findings for Victoria, in Washington State *Pubertal timing* and *Family history of antisocial behaviour* had more extensive associations than *Family conflict.* The effect of *Pubertal timing*, *Family history of antisocial behaviour*, and *Family conflict*, on transitions between latent statuses from Grades 5 to 6 in Washington State is shown in Table 3.9.

3.5.2.2.1 ***Pubertal timing***

Early maturation increased the risk that "non-drinkers with non-drinking friends" in Grade 5 would transition to have experimented with alcohol on their own (*OR* = 1.74) or would acquire one or two drinking friends while remaining non-drinkers (*OR* = 1.59) one year later compared to late/on-time maturing individuals and those with stable patterns. In addition, early maturing 5th graders in the "non-drinkers with 2 drinking friends" latent status were less likely to transition into the "non-drinkers with non-drinking friends" (*OR* = 0.87) or into the "experimenters with non-drinking friends" (*OR* = 0.83) latent statuses in Grade 6 compared to their late/on-time developing and stable counterparts. The effect of *Pubertal timing* on reverse peer influence transitions was evident in the "experimenters with non-drinking" latent peer status in Grade 5: Early developers and late/on-time developers had an equal odds of reverting to being non-drinkers who did not have any drinking close friends one year later (*OR* = 1.00).

Table 3.9
Odds ratios of Grade 5 snowball risk factors predicting transitions between latent peer statuses in Grades 5 and 6 in Washington State.

	Latent Status		
	Non-drinkers + non-drinking friends	Non-drinkers + 2 drinking friends	Experimenters + non-drinking friends
Effect of Pubertal timing on probability of transitioning to...	*...Grade 6 latent status*		
Conditional on Grade 5 latent status			
Non-drinkers + non-drinking friends	ref[l]	1.59	1.74
Non-drinkers + 2 drinking friends	0.87	ref	0.83
Experimenters + non-drinking friends	1.00[a]	0.94	ref
Effect of Family history of antisocial behaviour on probability of transitioning to...	*... Grade 6 latent status*		
Conditional on Grade 5 latent status			
Non-drinkers + non-drinking friends	ref	1.11	1.03
Non-drinkers + 2 drinking friends	0.99	ref	0.92
Experimenters + non-drinking friends	1.02[a]	1.10	ref
Effect of Family conflict on probability of transitioning to...	*... Grade 6 latent status*		
Conditional on Grade 5 latent status			
Non-drinkers + non-drinking friends	ref	1.07	1.05
Non-drinkers + 2 drinking friends	1.00	ref	1.05
Experimenters + non-drinking friends	1.01[a]	1.01	ref

ℓ = -2269.60. [a]Reverse peer influence transitions.

Note. All Grade 5 covariates entered simultaneously as predictors of Grade 5 to Grade 6 transitions. [1]Diagonal element of the transition matrix served as the reference category.

3.5.2.2.2 *Family history of antisocial behaviour*

Elevated level of *Family history of antisocial behaviour* raised the odds of acquiring one or two drinking best friends in Grade 6 (*OR* = 1.11) among the latent status of non-drinkers who had non-drinking close friends in the previous year. Among non-drinkers who had one or two drinking close friends in Grade 5, a one standard deviation increase in this predictor decreased the odds of transitioning into being experimenters who had non-drinking peers in Grade 6 by 8%. For the effect on reverse peer influence process, experimenters who had non-drinking friends at all levels of the risk factor had about the same odds of reverting to being non-drinkers and had non-drinking best friends in Grade 6 (*OR* = 1.02).

3.5.2.2.3 *Family conflict*

Among 5th graders in the "non-drinkers with non-drinking friends" latent status, they had an increased odds of acquiring one or two drinking peers while remaining non-drinkers (*OR* = 1.07), and experimenting with alcohol in the absence of drinking best friends (*OR* = 1.05) in Grade 6 when exposed to a one standard deviation increase in *Family conflict*. Further, among non-drinkers who were exposed to one or two drinking close friends in Grade 5, the odds for them to becoming experimenters but did not have any drinking close friends one year later raised by 5% with a one-unit increase in this predictor. For the effect on reverse peer influence process, again, the odds of reverting to being non-drinkers who had non-drinking best friends in Grade 6 from being experimenters without any drinking close friends in the previous year were about the same for individuals at all levels of the risk factor (*OR* = 1.01).

3.6 Summary

Findings revealed higher drinking rates in Victoria among Grades 5 and 6 students (eleven and twelve year-olds) compared to their same age counterparts in Washington State. The higher rates of alcohol use in Victoria were associated with more favourable peer norms. For example, experimenters who had drinking best friends in Victoria were more likely to perceive that peers would consider them as cool if they regularly used alcohol. In Washington State the probability of using alcohol regularly being perceived as cool was very low among adolescents in the same age group.

In broad terms many early adolescents tended to remain stable in not using alcohol and not associating with alcohol-using peers during their movement from Grade 5 to Grade 6. This was more apparent for Washington State (accounting for 65% of all transitions) than in Victoria (37% of transitions). A potentially important finding documented in the present study was that in early adolescence peer influence (as operationalised in this study) was not observed. In other words transitions between latent peer statuses motivated by the exposure of drinking best friends were not evident over the course of one year in this young cohort in either country. A somewhat unexpected finding was the presence of a reverse peer influence process whereby alcohol users that did not have drinking friends in Grade 5 reported not using alcohol one year later in Grade 6, evident for 19% in Victoria and 9% in Washington State. This observation confirmed that drinking behaviour among early adolescents was in some cases unstable, subject to transition, in both states. A peer selection process (whereby alcohol users that did not have drinking friends in Grade 5 reported using alcohol and having drinking friends in Grade 6) only emerged in the Victoria sample and applied to 9% of the sample.

In general, despite differences in rates of alcohol use, risk factors had generally similar effects in Washington State compared to Victoria in influencing alcohol-related developmental transitions toward either initiating alcohol use or

increasing associations with alcohol-using peers. Similar factors were identified to be associated with membership in latent peer subgroups in Grade 5 (five for each state) as well as transitions over the one-year period (three for each state). In particular, *Family history of antisocial behaviour* and to a lesser extent *Family conflict* predicted Grade 5 latent status membership, as well as transitions between latent statuses over time in both states; *Pubertal timing* predicted Grade 5 latent status membership and transitions between latent peer subgroups over time in Washington State only.

Chapter Four: Results for the middle cohort – Grades 7 and 8

This chapter reports results for the middle cohort where participants were in Grade 7 when they were first surveyed and followed up one year later in Grade 8. The chapter commences by presenting the general trends in drinking rates and the proportion of adolescents endorsing each of the observed binary indicators in both states. After selection of the final LTA models for each state, based on the fit statistics of competing models, labelling and interpretation of latent statuses were completed in line with the procedure outlined in Section 3.2. Next, descriptions of peer group patterns and characteristics, and the incidents of transitioning between latent peer statuses over time are presented. This is then followed by results of a series of hypothesis tests to identify statistically significant covariates for predicting Grade 7 latent status memberships and transitions over time. In addition to the snowball risk factors selected in Grade 7, four covariates selected to test snowstorm processes, including three protective factors in the school and family and the proportion of drinkers in the classroom, were also tested. Results from Victoria are presented first follow by results from Washington State. The chapter concludes with a summary of findings both cross-sectionally and prospectively in each state.

Table 4.1 shows the sample size and proportion endorsed for the eight observed binary indicators by state. Over half of 7th graders reported that they did not have any close friends who drank alcohol in both states (56% in Victoria vs. 61% in Washington State). Sixty-five percent of Grade 7 students in Victoria reported that they would be seen as cool if they started drinking regularly, and the figure rose to 77% by Grade 8. Whereas the percentage of adolescents in Washington State reporting "yes" to the same item were 36% and 50% respectively in Grades 7 and 8. In terms of drinking rates, 59% and 38% of 7th graders, respectively in Victoria and Washington State, had already tried alcohol in their lifetime. By Grade 8, 56% and 31% of fourteen year-olds in Victoria and Washington State respectively, had tried alcohol in the past 12 months. Forty-

four percent of Victorian adolescents used alcohol in the past 30 days prior to the survey in Grade 8, double the rate reported by their counterparts in Washington State (22%). Worryingly, 10% of 7th graders in Victoria reported that they had engaged in binge drinking in the past 2 weeks prior to the survey and the proportion rose to 18% one year later. The proportion of adolescents who engaged in binge drinking in Washington State was relatively low in comparison to Victorian youth (4% in Grade 7; 9% in Grade 8).

Table 4.1
Observed sample size and proportion endorsed for the eight binary indicators of self and peers drinking status for the middle cohort by state.

	Grade 7		Grade 8	
Binary indicators	*N*	Proportion (%)	*N*	Proportion (%)
		Victoria		
No drinking friends	531	56	335	36
1 to 2 drinking friends	253	27	282	30
3 to 4 drinking friends	162	17	321	34
Drink if friend offered at party	208	22	372	40
Be seen as cool if drink regularly	614	65	721	77
Bingeing during the past 2 weeks	94	10	163	18
Past 30 day alcohol use	294	31	409	44
Past year alcohol use	*	*	524	56
Lifetime alcohol use	558	59	*	*
		Washington State		
No drinking friends	575	61	427	46
1 to 2 drinking friends	255	27	309	33
3 to 4 drinking friends	112	12	192	21
Drink if friend offered at party	112	12	188	20
Be seen as cool if drink regularly	335	36	466	50
Bingeing during the past 2 weeks	38	4	80	9
Past 30 day alcohol use	111	12	200	22
Past year alcohol use	*	*	290	31
Lifetime alcohol use	358	38	*	*

*Not used in the respective wave.

4.1 Model selection among competing models

A series of LTA models with two to six latent statuses were run to identify the best fit model for each state. The model fit information of fitting LTA models ranging from two to six latent statuses in both states appear in Table 4.2. Although the six-latent-status model in both states had the lowest AIC and BIC values among the models, the five-latent-status model was chosen due to conceptual appeal after examination of its latent status profile and compared against the profile of the six-latent-status model. The latent status profile of the five-status model demonstrated good latent class separation and homogeneity in both states. Also a model with five latent statuses was more parsimonious for subsequent analyses incorporating covariates.

Table 4.2
Model fit information of fitting LTA models with two to six latent statuses for the middle cohort by state.

Number of latent statuses	G^2*	*df*	AIC	BIC	Log-likelihood
		Victoria			
2	4736.82	65516	4774.82	4867.25	-7593.57
3	3002.11	65503	3066.11	3221.79	-6726.22
4	2547.32	65488	2641.13	2869.78	-6517.61
5	**2071.88**	**65471**	**2199.88**	**2511.23**	**-6261.10**
6	1622.55	65452	1788.55	2192.33	-6036.43
		Washington State			
2	3841.33	65516	3879.33	3971.55	-6294.20
3	2395.63	65503	2459.63	2614.94	-5571.35
4	1879.59	65488	1973.59	2201.70	-5313.33
5	**1575.66**	**65471**	**1703.66**	**2014.27**	**-5161.36**
6	1362.68	65452	1528.68	1931.50	-5054.87

**p*-values not reported because the degrees of freedom are too large.

Note. Bold entries reflect selected model.

The hypothesis test of measurement invariance was conducted for the five-latent status models. For Victoria, the model with item-response probabilities constrained to be equal across time (G^2 = 2071.88 with 65471 *df*) was compared to one with item-response probabilities estimated freely (G^2 = 1961.46 with 65431 *df*). The difference G^2 of 110.42 was compared to a χ^2 table with *df* equal to 40 yielding a *p*-value < 0.001. For Washington State, the model with item-response probabilities constrained to be equal across time (G^2 = 1575.66 with 65471 *df*) was compared to one with item-response probabilities estimated freely (G^2 = 1419.54 with 65431 *df*). The difference G^2 of 156.12 was compared to a χ^2 table with *df* equal to 40 yielding a *p*-value < 0.001. These non-significance *p*-values indicate that the underlying structures of drinking behaviour differ across time in both states. Upon close examination of the item-response probabilities of the freely estimated model in each state, two and one out of 40 pairs of probabilities changed, respectively for Victoria and Washington State. These changes did not warrant a different labelling of the latent peer statuses in Grade 8. Thus, item-response probabilities were constrained to be equal across time in the final LTA model in both states.

4.2 Peer group patterns and characteristics

4.2.1 Final LTA model for Victoria

Table 4.3 depicts the final five-latent-status model that best described the peer group patterns in Victoria. The latent status profile consisted of two latent statuses of non-drinkers and three latent statuses of drinkers. The first latent peer status was characterised by individuals who reported none of their close friends used alcohol (probability = 1.00) and had low probabilities of having tried alcohol (0.20 and 0.02 for lifetime alcohol use and past 30 day alcohol use respectively). This latent status was labelled "non-drinkers with non-drinking friends". Similar to the first latent status, individuals who were assigned to the second latent peer subgroup were mostly non-drinkers but it was almost certain that they had one or

two close friends who drank (probability = 1.00). Therefore, this latent status was labelled "non-drinkers with 2 drinking friends". The third latent status, named "drinkers with non-drinking friends", was a group of individuals with high probability of having tried alcohol in their lifetime (probability = 0.91) and in the past 30 days (probability = 0.68). However, they did not have any alcohol-using best friends. Similar to the "drinkers with non-drinking friends" latent status, the fourth latent status also consisted of drinkers who had high probabilities of having tried alcohol in their lifetime (probability = 0.97) and in the past 30 days (probability = 0.80) but they had one or two drinking close friends (probability = 1.00). Thus, this latent peer subgroup was labelled "drinkers with 2 drinking friends". Furthermore, the fifth latent status was characterised by high probabilities of having three to four drinking friends (probability = 1.00), and using alcohol in the past 30 days (probability = 0.65) and in the participants' lifetime (probability = 0.82). Therefore, this latent status was named "drinkers with 4 drinking friends".

It can be noted that current drinkers who had drinking friends had a higher probability of reporting that they would accept alcoholic drinks if they were offered by friends at parties compared to non-drinkers (probability = 0.57 and 0.66 respectively for drinkers in the fourth and fifth latent peer statuses). Among these Victorian 7th and 8th graders, respondents tended to think they would be seen as cool if they started drinking regularly (probabilities ranged from 0.52 to 0.87), even among non-drinkers whose close friends did not drink (probability = 0.52).

Table 4.3
Five-Latent-Status Model of self-reported drinking statuses of adolescents and their peers in Grades 7 and 8 in Victoria (N = 958).

	Latent Status				
	Non-drinkers + non-drinking friends	Non-drinkers + 2 drinking friends	Drinkers + non-drinking friends	Drinkers + 2 drinking friends	Drinkers + 4 drinking friends
*Item-response probabilities of a "Yes" response (G7 & G8)**					
No drinking friends	**1.0000**[†]	0.0000	**1.0000**	0.0000	0.0000
1 to 2 drinking friends	0.0000	**1.0000**	0.0000	**1.0000**	0.0000
3 to 4 drinking friends	0.0000	0.0000	0.0000	0.0000	**1.0000**
Drink if friend offered at party	0.0135	0.1005	0.2836	**0.5697**	**0.6638**
Be seen as cool if drink regularly	**0.5228**	**0.6754**	**0.7075**	**0.8648**	**0.8719**
Bingeing during the past 2 weeks	0.0020	0.0035	0.0997	0.2199	0.3592
Past 30 day alcohol use	0.0154	0.0000	**0.6753**	**0.8000**	**0.6539**
Lifetime alcohol use (Past year alcohol use in Grade 8)[1]	0.2010	0.2937	**0.9079**	**0.9711**	**0.8167**
Prevalence of latent status					
Grade 7 (G7)	41%	13%	15%	14%	17%
Grade 8 (G8)	25%	16%	11%	15%	34%
Probability of transitioning to ...	*...Grade 8 latent status*				
Conditional on Grade 7 latent status					
Non-drinkers + non-drinking friends	**0.48**[‡]	0.23	0.09	0.07	0.13
Non-drinkers + 2 drinking friends	0.21	**0.30**	0.07	0.13[b]	0.30[b]
Drinkers + non-drinking friends	0.10[a]	0.04	**0.25**	0.23[c]	0.39[c]
Drinkers + 2 drinking friends	0.04	0.05	0.14	**0.31**	0.46
Drinkers + 4 drinking friends	0.04	0.06	0.04	0.12	**0.75**

ℓ = -6261.10.
*Item-response probabilities constrained to be equal across times. [†]Item-response probabilities > 0.5 in bold to facilitate interpretation.
[1]Alcohol use indicator used in Grade 8. [‡]Diagonal transition probabilities in bold in bottom rows to facilitate interpretation.
[a]Reverse peer influence transition. [b]Peer influence transitions. [c]Peer selection transitions.

The prevalence of each latent status in Grades 7 and 8 appear in the middle rows of Table 4.3. In Grade 7, the most prevalent latent status consisted of 41% of 12- to 13-year-olds who were classified as non-drinkers who had non-drinking best friends, followed by the "drinkers with 4 drinking friends" latent peer status (17%). However by Grade 8, the most prevalent peer subgroup became the "drinkers with 4 drinking friends" latent status which accounted for 34% of 14 year-olds. The proportion of the "non-drinkers with non-drinking friends" latent status decreased to 25% and it became the second most common latent status in Grade 8.

4.2.2 Final LTA model for Washington State

Table 4.4 presents the final five-latent-status model which was found to best explain the heterogeneity of peer groups in Washington State. The latent status profile consisted of two latent statuses with non-drinkers, one latent status with experimenters, and two latent statuses with drinkers. The first latent status was characterised by a very high probability of having non-drinking best friends (probability = 1.00) and very low probability of having tried alcohol in their lifetime in Grade 7 and in the past year in Grace 8 (probability = 0.16), and in the past 30 days (probability = 0.03). This latent peer subgroup was labelled "non-drinkers with non-drinking friends". The second latent status also consisted of non-drinkers but they were almost certain to reported having one or two drinking close friends (probability = 1.00). This latent status was named "non-drinkers with 2 drinking friends". The third latent peer status was characterised by a high probability of having three or four drinking close friends (probability = 1.00) and a moderate probability of having tried alcohol in their lifetime (probability = 0.50). The label for this latent status was "experimenters with 4 drinking friends".

Table 4.4
Five-Latent-Status Model of self-reported drinking statuses of adolescents and their peers in Grades 7 and 8 in Washington State (N = 947).

	Latent Status				
	Non-drinkers + non-drinking friends	Non-drinkers + 2 drinking friends	Experimenters + 4 drinking friends	Drinkers + 2 drinking friends	Drinkers + 4 drinking friends
*Item-response probabilities of a "Yes" response (G7 & G8)**					
No drinking friends	**1.0000**[†]	0.0000	0.0000	0.0000	0.0545
1 to 2 drinking friends	0.0000	**1.0000**	0.0000	**1.0000**	0.0000
3 to 4 drinking friends	0.0000	0.0000	**1.0000**	0.0000	**0.9455**
Drink if friend offered at party	0.0229	0.0651	0.1789	**0.6118**	**0.8207**
Be seen as cool if drink regularly	0.2813	0.4457	**0.5809**	**0.7519**	**0.8548**
Bingeing during the past 2 weeks	0.0040	0.0025	0.0246	0.2350	0.4558
Past 30 day alcohol use	0.0313	0.0278	0.0642	**0.7790**	**0.8734**
Lifetime alcohol use (Past year alcohol use in G8)[1]	0.1613	0.2485	**0.5041**	**1.0000**	**0.9919**
Prevalence of latent status					
Grade 7 (G7)	61%	20%	7%	7%	5%
Grade 8 (G8)	45%	24%	9%	9%	13%
Probability of transitioning to ... Conditional on G7 latent status			*...G8 latent status*		
Non-drinkers + non-drinking friends	**0.61**[‡]	0.25	0.05	0.05	0.04
Non-drinkers + 2 drinking friends	0.35	**0.32**	0.13[a]	0.08[a]	0.13[a]
Experimenters + 4 drinking friends	0.12	0.25	**0.23**	0.17	0.23
Drinkers + 2 drinking friends	0.08	0.10	0.13	**0.25**	0.44
Drinkers + 4 drinking friends	0.04	0.05	0.14	0.24	**0.53**

ℓ = -5161.37. [1]Alcohol use indicator used in Grade 8.
*Item-response probabilities constrained to be equal across times. [†]Item-response probabilities > 0.5 in bold to facilitate interpretation.
[‡]Diagonal transition probabilities in bold in bottom rows to facilitate interpretation. [a]Peer influence transitions.

Furthermore, the fourth latent status consisted of current drinkers who had a high probability of having tried alcohol in their lifetime in Grade 7 and in the past year in Grade 8 (probability = 1.00) and in the past 30 days (probability = 0.78). These individuals were also almost certain to have had one or two alcohol-using close friends (probability = 1.00). Thus, this latent status was named "drinkers with 2 drinking friends". The fifth latent status was also characterised by having drinkers who used alcohol during the past 30 days at both time points (probability = 0.87) and they had high probability of having three or four best friends who drank (probability = 0.95). This latent status was labelled "drinkers with 4 drinking friends".

In contrast to their Victorian counterparts, only those who had already tried alcohol or were currently drinking and associated with drinking close friends considered that they would be seen as cool if they started using alcohol regularly (probabilities range from 0.58 to 0.85). Moreover, only those who were current drinkers and had drinking friends would accept alcoholic drinks if they were offered by friends at parties (probability = 0.61 and 0.82 for the fourth and fifth latent statuses respectively).

According to the prevalence of each latent status which appears in the middle rows of Table 4.4, in both grade levels, the most prevalent latent peer status was the "non-drinkers with non-drinking friends". The proportion of 7th and 8th graders who were categorised as non-drinkers in this latent status was 61% and 45% respectively. The second most common latent status was the "non-drinkers with 2 drinking friends" latent status (20% in Grade 7; 24% in Grade 8. Although only 5% of 7th graders were classified as current drinkers who had three to four drinking friends, the proportion who were assigned to this same latent status more than doubled to 13% one year later.

4.2.3 Similarities and differences between states

LTA models with the same number of latent status were identified as optimal models for both states but with one latent status difference. There was a group of current drinkers who had started drinking on their own in the absence of alcohol-using best friends in Victoria; whereas in Washington State the different latent peer subgroup was a group of experimenters who had three or four drinking friends. Although four latent statuses were similar, the proportions of non-drinkers and current drinkers were different. There were 20% more non-drinkers who had no drinking close friends in Grades 7 and 8 in Washington State compared to Victoria. In addition, the proportion of Victorian youth who were current drinkers and had three or four drinking best friends in Grades 7 (17% in Victoria vs. 5% in Washington State) and 8 (34% in Victoria vs. 13% in Washington State) was more than double that of their counterparts in both grade levels in Washington State. One similarity between the states was that only those who were currently drinking and had alcohol-using close friends would accept alcoholic drinks offered by their friends at parties in both states. A state difference was evident in perceived peer norms relating to alcohol use. While most Victorian youth at both time points thought they would be seen as cool if they started drinking regularly, only those who had started experimenting with alcohol or were currently drinking and had close friends who drank would endorse this item in Washington State.

4.3 Movements between latent peer subgroups over time

4.3.1 Transitions over time in Victoria

The bottom rows of Table 4.3 show the probabilities of transitioning between latent statuses over time during the one-year period in Victoria.

Transition probabilities in diagonal are the probabilities of staying in the same latent status one year later and are presented in bold to facilitate interpretation. Among those who were non-drinkers and did not have any drinking close friends in Grade 7, the probability of staying as non-drinkers and not having any close friends who used alcohol in Grade 8 was 0.48. If these non-drinkers were to make transitions, they were most likely to transition to the "non-drinkers with 2 drinking friends" latent status one year later (probability = 0.23). Non-drinking adolescents who reported having one or two best friends who drank had a 0.30 probability of being in the same latent status in Grade 8. Among this same group of non-drinkers who made transitions, they were most likely to transition to being in the "drinkers with 4 drinking friends" latent status one year later (probability = 0.30). This transition was congruent with the features of peer influence; non-drinking 7th graders exposed to drinking friends became current drinkers in Grade 8. Another transition was observed that was congruent with peer influence in this latent peer status in which non-drinkers with drinking friends had a 0.13 probability of becoming current drinkers with one or two drinking friends in Grade 8.

Two transitions that were congruent with peer selection were found in the "drinkers with non-drinking friends" latent status: Individuals had a 23% and 39% chance of transitioning to being in the "drinkers with 2 drinking friends" latent status and "drinkers with 4 drinking friends", respectively one year later. In addition, a transition congruent with reverse peer influence was only observed in this latent peer subgroup; the probability to have stopped drinking by Grade 8 was 0.10. Once adolescents started drinking and had best friends who also used alcohol, the contribution of peer influence and selection processes became less clear in that transitions into riskier latent peer statuses had features congruent with both peer mechanisms. As evident in the "drinkers with 2 drinking friends" latent status, 7th graders had a 46% chance of acquiring more drinking close friends one year later. The second most common "movement" for this latent peer status was staying in the same latent status one year later; the probability of staying as drinkers who had one or two drinking close friends was 0.31.

Further, the "drinkers with 4 drinking friends" latent status displayed the highest stability (probability = 0.75) out of all the other latent peer subgroups. This means that those who started as drinkers and had three or four drinking best friends in Grade 7 had a 75% chance of being in the same latent status in Grade 8. Among these current drinkers who transitioned, they were most likely to lose one or two drinking friends but stay being drinkers (probability = 0.12) one year later and the probabilities for them to transition to a less risky peer subgroups (i.e. being current drinkers with no drinking peers or being non-drinkers with drinking peers) or to revert to being non-drinkers in Grade 8 were very low.

4.3.2 Transitions over time in Washington State

The transition probability matrix for Washington State is shown in the bottom section of Table 4.4. In overview transitions in Washington State showed many similar features to Victoria, although a more conservative movement into alcohol use was apparent. The "non-drinkers with non-drinking friends" latent status showed the highest stability among the latent statuses; these 7th graders had a 61% chance of remaining in the same latent status by Grade 8. Among non-drinkers who made transitions, they were most likely to transition to have had one or two drinking best friends but stayed in the same drinking status one year later (probability = 0.25). Moreover, among non-drinkers who had one or two drinking friends in Grade 7, they had a 32% chance of remaining in the same latent subgroup one year later. For these non-drinkers who made transitions, they were most likely to have had non-drinking close friends in Grade 8 (probability = 0.35). This was a transition that was incongruent with the expectations of peer influenced alcohol use. Three transitions that were congruent with peer influence processes were also observed in this latent peer status. Non-drinkers who had one or two drinking friends had the same probability of 0.13 to transition to becoming either experimenters or current drinkers and having acquired three or four close friends who drank by Grade 8. This latent status of non-drinking 7th graders also

had an 8% chance of becoming drinkers and retained one or two drinking friends one year later.

Transitions that may have been motivated by both peer influence and selection processes were evident in the "experimenters with 4 drinking friends", and "drinkers with 2 drinking friends" latent statuses. The probabilities for experimenters to transition to being current drinkers who had one or two drinking friends, and had three or four drinking friends one year later were 0.17 and 0.23, respectively. Among current drinkers who had one or two drinking friends in Grade 7, they had a 44% chance of having more drinking friends by Grade 8. Additionally, those who were also current drinkers but had three to four drinking friends in Grade 7 displayed high stability in remaining in the same latent peer status one year later (probability = 0.53).

Similarities with Victoria were observed in the relatively large group remaining stable non-drinkers with non-drinking friends from Grades 7 to 8, although this stability accounted for more of the sample in Washington State (37%) than Victoria (20%). The proportions in each latent status showing stable patterns were generally similar in the two states. One difference was that the tendency to be stably located as a drinker with three or four drinking friends accounted for more of the sample in Victoria (13%) than in Washington State (3%).

There were two transitions that were relevant to peer processes and were observed only in Victoria, congruent with reverse peer influence (2% of the sample) and peer selection (9%). Transitions congruent with peer influence were observed for similar numbers in both states (Victoria 6%; Washington State 8%).

4.4 Effect of covariates

In addition to the snowball risk factors in Grade 7, *Proportion of drinkers in classroom* and three protective factors, namely, *Opportunities for prosocial involvement in the family*, *Opportunities for prosocial involvement at school*, and *Involvement in clubs* were tested in the middle cohort. Results of hypothesis tests for predictors of membership of Grade 7 latent statuses for both states were presented in Table 4.5. Three and five factors were found to have reached statistical significance as predictors of latent status membership in Grade 7 in Victoria and Washington State respectively. *Family history of antisocial behaviour* ($p < 0.001$ for both states), *Poor family poor management* ($p < 0.001$ for both states), and *Parental attitudes favourable towards drug use* ($p < 0.001$ for Victoria; $p = 0.001$ for Washington State), predicted Grade 7 latent status membership in both states. Besides these, *Proportion of drinkers in the classroom* ($p = 0.048$) and *Family conflict* ($p = 0.015$) predicted latent status membership in Grade 7 only in Washington State.

Prospectively, four covariates were identified as predictors associated with transitions between latent statuses over time for each state according to Table 4.6. Three of these predictors identified were the same for both states: *Pubertal timing* ($p < 0.001$ for both states), *Proportion of drinkers in the classroom* ($p = 0.003$ for Victoria; $p = 0.008$ for Washington State), and *Family history of antisocial behaviour* ($p < 0.001$ for both states). In addition, two factors predicted in only one state, *Family conflict* ($p < 0.001$) and *Opportunities for prosocial involvement at school* ($p = 0.047$) were found to be statistically significant predictors in only Victoria and Washington State respectively.

Table 4.5
Hypothesis tests for predictors of Grade 7 latent status membership by state.

Covariate	ℓ Removing Covariate (ℓ_1)	Likelihood-ratio Statistic*	*df*	*p*-value
		Victoria		
Gender	-5695.02	5.80	4	0.214
Pubertal timing	-5694.35	4.46	4	0.348
Proportion of drinkers in the classroom (%)	-5695.48	6.71	4	0.152
Family history of antisocial behaviour	-5719.65	55.06	4	**<0.001**
Poor family management	-5704.58	24.91	4	**<0.001**
Family conflict	-5693.44	2.63	4	0.620
Parental attitudes favourable towards drug use	-5704.70	25.15	4	**<0.001**
Opportunities for prosocial involvement in the family	-5694.77	5.28	4	0.259
Opportunities for prosocial involvement at school	-5692.85	1.45	4	0.834
Involvement in clubs	-5693.26	2.26	4	0.686
		Washington State		
Gender	-4331.37	7.71	4	0.102
Pubertal timing	-4329.10	3.15	4	0.531
Proportion of drinkers in the classroom (%)	-4332.32	9.60	4	**0.048**
Family history of antisocial behaviour	-4384.99	114.94	4	**<0.001**
Poor family management	-4348.88	26.72	4	**<0.001**
Family conflict	-4333.70	12.36	4	**0.015**
Parental attitudes favourable towards drug use	-4336.41	17.77	4	**0.001**
Opportunities for prosocial involvement in the family	-4328.66	2.28	4	0.683
Opportunities for prosocial involvement at school	-4328.58	2.11	4	0.713
Involvement in clubs	-4328.68	2.31	4	0.677

*Calculated using $-2(\ell_1 - \ell_2)$. Victoria $\ell_2 = -5692.13$. Washington State $\ell_2 = -4327.52$. *p*-values of statistically significant covariates are highlighted in bold.
Note. All covariates entered simultaneously as predictors of Grade 7 latent status membership.

Table 4.6
Hypothesis tests for predictors of transitions between latent peer statuses in Grades 7 and 8 by state.

Covariates	ℓ Removing Covariate (ℓ_1)	Likelihood-ratio Statistic*	*df*	*p*-value
		Victoria		
Gender	-5786.29	8.24	20	0.990
Pubertal timing	-5935.08	305.82	20	**<0.001**
Proportion of drinkers in classroom (%)	-5802.93	41.52	20	**0.003**
Family history of antisocial behaviour	-5866.78	169.22	20	**<0.001**
Poor family management	-5784.36	4.38	20	0.999
Family conflict	-5812.19	60.04	20	**<0.001**
Parental attitudes favourable towards drug use	-5795.19	26.04	20	0.164
Opportunities for prosocial involvement in the family	-5794.95	25.56	20	0.181
Opportunities for prosocial involvement at school	-5797.87	31.40	20	0.050
Involvement in clubs	-5786.67	9.00	20	0.983
		Washington State		
Gender	-4481.37	5.08	20	0.999
Pubertal timing	-4641.48	325.30	20	**<0.001**
Proportion of drinkers in classroom (%)	-4497.93	38.20	20	**0.008**
Family history of antisocial behaviour	-4592.11	226.56	20	**<0.001**
Poor family management	-4491.56	25.46	20	0.184
Family conflict	-4493.41	29.16	20	0.085
Parental attitudes favourable towards drug use	-4480.84	4.02	20	0.999
Opportunities for prosocial involvement in the family	-4480.67	3.68	20	0.999
Opportunities for prosocial involvement at school	-4494.68	31.70	20	**0.047**
Involvement in clubs	-4479.74	1.82	20	0.999

*Calculated using $-2(\ell_1 - \ell_2)$. Victoria $\ell_2 = -5782.17$. Washington State $\ell_2 = -4478.83$. *p*-values of statistically significant covariates are highlighted in bold.
Note. All covariates entered simultaneously as predictors of transitions between Grade7 and Grade 8 latent status memberships.

4.4.1 Predicting Grade 7 latent membership

Table 4.7 and 4.8 depict the effect of each statistically significant covariate predicting Grade 7 latent status membership in regression coefficients and odds ratios for Victoria and Washington State respectively. The reference category in the multinomial logistic regressions was the "non-drinkers with non-drinking friends" latent status in both states. All covariates were entered simultaneously as predictors of Grade 7 latent status memberships. The interpretation of odds ratios is the same as outlined in Section 3.5.1. In both states, as covariates increase, the odds of being in the riskier latent status memberships (i.e., having drinking best friends or escalated drinking statuses) increase.

4.4.1.1 Effect of covariates in Victoria

Referring to Table 4.7, with a one standard deviation increase in *Family history of antisocial behaviour*, the odds increased by 21% (*OR* = 1.21) of being in the "non-drinkers with 2 drinking friends" and "drinkers with non-drinking friends" latent statuses in relation to the reference category while controlling for all other covariates. The odds of being in the "drinkers with 2 drinking friends" and "drinkers with 4 drinking friends" latent statuses also increased by 42% and 66%, respectively, with a one standard deviation increase in the predictor. Elevated levels on *Poor family management* increased the odds of being in riskier latent status memberships; the odds ratios ranged from 1.16 ("drinkers with non-drinking friends" latent status) to 1.47 (being drinkers who had three to four drinking best friends). Similar results were noted in *Parental attitudes favourable towards drug use*; with one standard deviation increase in the predictor, the odds increased by 23% to 29% in being current drinkers with or without drinking friends.

Table 4.7
Regression coefficients and odds ratios of statistically significant predictors of membership in Grade 7 latent statuses in Victoria.

	Grade 7 Latent Status				
	Non-drinkers + non-drinking friends	Non-drinkers + 2 drinking friends	Drinkers + non-drinking friends	Drinkers + 2 drinking friends	Drinkers + 4 drinking friends
Intercept					
Beta	ref[1]	-1.20	-0.99	-1.07	-0.95
Odds	ref	0.30	0.37	0.34	0.39
Family history of antisocial behaviour					
Beta	ref	0.18	0.19	0.35	0.50
Odds Ratios	ref	1.21	1.21	1.42	1.66
Poor family management					
Beta	ref	0.20	0.14	0.23	0.38
Odds Ratios	ref	1.22	1.16	1.26	1.47
Parental attitudes favourable towards drug use					
Beta	ref	0.01	0.21	0.26	0.20
Odds Ratios	ref	1.01	1.23	1.29	1.23

ℓ = -5692.13.

Note. All covariates entered simultaneously as predictors of Grade 7 latent status membership.

[1]The "non-drinkers with non-drinking friends" latent status served as the reference category in multinomial logistic regression analyses.

Table 4.8
Regression coefficients and odds ratios of statistically significant predictors of membership in Grade 7 latent statuses in Washington State.

	Grade 7 Latent Status				
	Non-drinkers + non-drinking friends	Non-drinkers + 2 drinking friends	Experimenters + 4 drinking friends	Drinkers + 2 drinking friends	Drinkers + 4 drinking friends
Intercept					
Beta	ref[1]	-0.99	-2.50	-3.45	-3.99
Odds	ref	0.37	0.08	0.03	0.02
Family history of antisocial behaviour					
Beta	ref	0.33	0.90	1.37	1.46
Odds Ratios	ref	1.38	2.47	3.95	4.34
Poor family management					
Beta	ref	0.32	0.41	0.75	1.05
Odds Ratios	ref	1.38	1.51	2.12	2.87
Parental attitudes favourable towards drug use					
Beta	ref	0.08	0.34	0.68	0.26
Odds Ratios	ref	1.08	1.41	1.97	1.30
Family conflict					
Beta	ref	0.23	0.50	0.32	0.49
Odds Ratios	ref	1.26	1.66	1.38	1.64
Proportion of drinkers in the classroom (%)					
Beta	ref	0.22	0.33	0.18	0.63
Odds Ratios	ref	1.25	1.40	1.20	1.87

ℓ = -4327.52. *Note*. All covariates entered simultaneously as predictors of Grade 7 latent status membership.
[1]The "non-drinkers with non-drinking friends" latent status served as the reference category in multinomial logistic regression analyses.

4.4.1.2 Effect of covariates in Washington State

Findings were generally similar for Washington State compared to Victoria, however there were more risk factors and their effects were generally larger. As can be seen in Table 4.8, the higher the level of these statistically significant covariates reported by adolescents, the higher the odds of being in the riskier latent peer subgroups. A one standard deviation increase in *Family history of antisocial behaviour* raised the odds of being in the riskier latent peer statuses, relative to the reference latent status, by between 38% (*OR* = 1.38, "non-drinkers with 2 drinking friends" latent status) and 334% (*OR* = 4.34, "drinkers with 4 drinking friends" latent status). Elevated levels in *Poor family management* increased the odds of being in the riskier latent statuses by 38% (*OR* = 1.38, "non-drinkers with 2 drinking friends" latent status) to 187% (*OR* = 2.87, "drinkers with 4 drinking friends" latent status) relative to the reference latent status. Further, the odds ratios of being in riskier latent status memberships ranged from 1.08 (being non-drinkers who had one or two drinking friends) to 1.97 (being current drinkers with one or two drinking friends) with a one standard deviation increase in *Parental attitudes favourable towards drug use*. An increase in *Family conflict* raised the odds of being in other latent peer subgroups from between 26% (*OR* = 1.26, "non-drinkers with 2 drinking friends" latent status) and 66% (*OR* = 1.66, "experimenters with 4 drinking friends" latent status). Additionally, the higher the *Proportion of drinkers in classroom*, the higher the odds of being in riskier latent peer subgroups, with odds ratios ranging from 1.20 (being current drinkers who had one or two drinking friends) to 1.87 (being drinkers who had three or four drinking friends).

4.4.2 Predicting transitions over time

Table 4.9 and 4.10 show the odds ratios for each statistically significant predictor of transitions from Grade 7 to Grade 8 latent statuses for Victoria and Washington State respectively. All covariates were entered simultaneously in the

final LTA models. The interpretation of odds ratios is the same as outlined in Section 3.5.2. The diagonal elements of the transition matrices served as the reference group in the multinomial logistic regression analyses for each row. All odds ratios are interpreted as the effect of the covariate on the odds of transitioning from a latent status at Time 1 to another latent status at Time 2, relative to being in the same latent status at Time 2. Again, the presentation of results is focused on the effects of statistically significant predictors on peer influence or selection transitions.

4.4.2.1 Effect of covariates on transitions over time in Victoria

The effect of *Pubertal timing*, *Family history of antisocial behaviour*, *Proportion of drinkers in the classroom*, and *Family conflict* on prospective transitions in Victoria is presented in Table 4.9.

Table 4.9
Odds ratios of statistically significant predictors of transitions between latent peer statuses in Grades 7 and 8 in Victoria.

	Latent Status				
	Non-drinkers + non-drinking friends	Non-drinkers + 2 drinking friends	Drinkers + non-drinking friends	Drinkers + 2 drinking friends	Drinkers + 4 drinking friends
Effect of Pubertal timing on probability of transitioning to...			*...Grade 8 latent status*		
Conditional on Grade 7 latent status					
Non-drinkers + non-drinking friends	ref[d]	0.99	1.19	0.98	1.04
Non-drinkers + 2 drinking friends	1.00	ref	1.31	1.13[b]	0.99[b]
Drinkers + non-drinking friends	1.01[a]	0.95	ref	1.16[c]	1.20[c]
Drinkers + 2 drinking friends	0.93	0.93	1.02	ref	1.01
Drinkers + 4 drinking friends	0.96	1.02	1.17	1.02	ref
	Non-drinkers + non-drinking friends	Non-drinkers + 2 drinking friends	Drinkers + non-drinking friends	Drinkers + 2 drinking friends	Drinkers + 4 drinking friends
Effect of Family history of antisocial behaviour on probability of transitioning to...			*... Grade 8 latent status*		
Conditional on Grade 7 latent status					
Non-drinkers + non-drinking friends	ref	0.95	1.11	1.09	1.15
Non-drinkers + 2 drinking friends	1.09	ref	1.05	1.03[b]	1.07[b]
Drinkers + non-drinking friends	0.97[a]	0.96	ref	1.08[c]	1.07[c]
Drinkers + 2 drinking friends	0.99	0.94	1.00	ref	1.06
Drinkers + 4 drinking friends	0.91	0.96	0.81	0.91	ref

Table 4.9 (continued)

	Latent Status				
	Non-drinkers + non-drinking friends	Non-drinkers + 2 drinking friends	Drinkers + non-drinking friends	Drinkers + 2 drinking friends	Drinkers + 4 drinking friends
Effect of Proportion of drinkers in the classroom (%) on probability of transitioning to...			*... Grade 8 latent status*		
Conditional on Grade 7 latent status					
Non-drinkers + non-drinking friends	ref	1.08	1.00	1.09	0.98
Non-drinkers + 2 drinking friends	1.01	ref	0.96	0.99[b]	1.01[b]
Drinkers + non-drinking friends	1.02[a]	1.06	ref	1.07[c]	1.01[c]
Drinkers + 2 drinking friends	1.01	1.03	0.97	ref	0.92
Drinkers + 4 drinking friends	1.00	1.02	0.83	1.00	ref

	Non-drinkers + non-drinking friends	Non-drinkers + 2 drinking friends	Drinkers + non-drinking friends	Drinkers + 2 drinking friends	Drinkers + 4 drinking friends
Effect of Family conflict on probability of transitioning to...			*... Grade 8 latent status*		
Conditional on Grade 7 latent status					
Non-drinkers + non-drinking friends	ref	1.09	1.10	1.10	1.00
Non-drinkers + 2 drinking friends	0.95	ref	0.99	1.00[b]	0.98[b]
Drinkers + non-drinking friends	0.96[a]	1.01	ref	1.02[c]	1.03[c]
Drinkers + 2 drinking friends	0.98	1.02	1.01	ref	0.98
Drinkers + 4 drinking friends	0.96	1.09	1.09	1.02	ref

ℓ = -5782.17. *Note*. All covariates entered simultaneously as predictors of Grade 7 to Grade 8 transitions. [1]Diagonal element of the transition matrix served as the reference category. [a]Reverse peer influence transition. [b]Peer influence transitions. [c]Peer selection transitions.

4.4.2.1.1 *Pubertal timing*

The moderating effect of *Pubertal timing* on peer influence transitions was evident in the Grade 7 "non-drinkers with non-drinking friends" with this risk factor having a greater likelihood (*OR* = 1.19) of transitioning to "drinking with non-drinking friends". This covariate also influenced transitions to drinking in the "non-drinkers with 2 drinking friends" latent peer status in Grade 7. Early maturing 7th graders in this latent peer status were 1.31 times more likely to transition to current drinking with non-drinking friends and 1.13 times more likely to transition to current drinking with one or two drinking peers one year later, relative to late/on-time maturers and those who did not make any transition during the year. However, early developers and late/on-time developers had about the same odds of transitioning to being current drinkers who had three or four drinking best friends (*OR* = 0.99) in Grade 8. Further, the effect of *Pubertal timing* on transitions congruent with peer selection and reverse peer influence processes was evident in the latent subgroup of current drinkers who had non-drinking close friends in Grade 7. Early maturing drinkers who did not have any drinking close friends in Grade 7 were more likely to have acquired one or two drinking peers (*OR* = 1.16), and three to four drinking friends (*OR* = 1.20) but remained current drinkers in Grade 8, compare to late/on-time maturers (peer selection process). Moreover, among this same latent subgroup of current drinkers in Grade 7 who were early maturers had about the same odds as their late/on-time maturing counterparts (*OR* = 1.01) to revert to being non-drinkers who had non-drinking best friends in Grade 8 (reverse peer influence process).

4.4.2.1.2 *Family history of antisocial behaviour*

In regards to potentially peer influence transitions, a one standard deviation increase in this predictor was associated with a 7% higher odds of transitioning in the "drinkers with 4 drinking friends" (*OR* = 1.07) latent status in Grade 8, among non-drinkers who had one or two drinking best friends in the previous year, in relation to those who did not transition. However, 7th graders in this same latent subgroup of non-drinkers had about the same odds of remaining as current drinkers who had one

or two drinking peers one year later at all levels of the predictor (*OR* = 1.03). With respect to transitions congruent with peer selection, this risk factor was associated with an elevated odds of transitions that increased drinking peers among 7th graders who had started using alcohol in the absence of drinking peers: The odds for them to transition to being in the "drinkers with 2 drinking friends" and "drinkers with 4 drinking friends" latent statuses were raised by 8% and 7% respectively. Moreover, current drinkers who had non-drinking close friends in Grade 7 had about the same odds of transitioning into the "non-drinkers with non-drinking friends" at all levels of *Family history of antisocial behaviour* (*OR* = 0.97; reverse peer influence process).

4.4.2.1.3 ***Proportion of drinkers in the classroom***

This covariate tended to have little influence on transitions that were congruent with peer influence, however there was some evidence of influence on peer selection. For the moderating effect of this predictor on transitions congruent with peer influence processes, 7th graders belong to the "non-drinkers with 2 drinking friends" latent status had about the same odds of transitioning to becoming current drinkers who had one or two drinking close friends (*OR* = 0.99), and to being in the "drinkers with 4 drinking friends" latent status (*OR* = 1.01), relative to those who remained in the same latent status one year later, at all levels of *Proportion of drinkers in classroom*. Furthermore, among current drinkers who had non-drinking friends in Grade 7, a one standard deviation increase in the predictor associated with a 7% increase in the odds of transitioning into the "drinkers with 2 drinking friends" latent status (congruent with a peer selection transition) one year later. However, for the same latent subgroup of current drinkers in Grade 7, the odds of transitioning into the "drinkers with 4 drinking friends" latent status (*OR* = 1.01; peer selection transition) and to revert to being non-drinkers and had no drinking peers (*OR* = 1.02; reverse peer influence transition) were about the same for individuals at all levels of the predictor.

4.4.2.1.4 *Family conflict*

This predictor was only statistically significant in moderating transitions between latent peer statuses in Victoria. This predictor tended to have little influence on transitions that were congruent with peer influence or selection. The odds of making transitions congruent with peer influence, peer selection, and reverse peer influence processes were about the same for individuals at all levels of the predictor. The odds ratios for the peer influence transitions from being in the "non-drinkers with 2 drinking friends" latent status in Grade 7 to being in the "drinkers with 2 drinking friends" and "drinkers with 4 drinking friends" latent statuses were 1.00 and 0.98 respectively. Moreover, among current drinkers who had non-drinking peers, the odds of transitioning into being in the "drinkers with 2 drinking friends" (*OR* = 1.02; peer selection process), "drinkers with 4 drinking friends" (*OR* = 1.03; peer selection process), and "non-drinkers with non-drinking friends" (*OR* = 0.96; reverse peer influence process), were about the same at all levels of the predictor. Nevertheless, the moderating effect of *Family conflict* had a larger effect on transitions by 7th graders in the "non-drinkers with non-drinking friends" latent status; they had an increased odds of transitioning into the "non-drinkers with 2 drinking friends" (*OR* = 1.09), the "drinkers with non-drinking friends" (*OR* = 1.10) and "drinkers with 2 drinking friends" (*OR* = 1.10) latent statuses one year later with a one-unit increase in the predictor, relative to those who did not transition during the one-year period.

4.4.2.2 Effect of covariates on transitions over time in Washington State

Table 4.10 shows the effect of *Pubertal timing*, *Family history of antisocial behaviour*, *Proportion of drinkers in the classroom*, and *Opportunities for prosocial involvement at school* on transitions over time in Washington State. The effects were generally in a similar direction to those observed in Victoria.

Table 4.10
Odds ratios of statistically significant predictors of transitions between latent peer statuses in Grades 7 and 8 in Washington State.

	Latent Status				
	Non-drinkers + non-drinking friends	Non-drinkers + 2 drinking friends	Experimenters + 4 drinking friends	Drinkers + 2 drinking friends	Drinkers + 4 drinking friends
Effect of Pubertal timing on probability of transitioning to... Conditional on Grade 7 latent status			*...Grade 8 latent status*		
Non-drinkers + non-drinking friends	ref[l]	1.11	1.03	1.03	0.78
Non-drinkers + 2 drinking friends	0.92	ref	1.17[a]	1.10[a]	1.11[a]
Experimenters + 4 drinking friends	1.11	0.99	ref	1.03	0.97
Drinkers + 2 drinking friends	0.89	1.04	1.00	ref	0.95
Drinkers + 4 drinking friends	1.07	0.91	0.97	0.94	ref
	Non-drinkers + non-drinking friends	Non-drinkers + 2 drinking friends	Experimenters + 4 drinking friends	Drinkers + 2 drinking friends	Drinkers + 4 drinking friends
Effect of Family history of antisocial behaviour on probability of transitioning to... Conditional on Grade 7 latent status			*... Grade 8 latent status*		
Non-drinkers + non-drinking friends	ref	1.04	1.29	1.14	1.29
Non-drinkers + 2 drinking friends	0.99	ref	1.04[a]	1.00[a]	1.00[a]
Experimenters + 4 drinking friends	0.96	0.98	ref	0.97	1.01
Drinkers + 2 drinking friends	0.96	0.95	1.01	ref	1.00
Drinkers + 4 drinking friends	1.07	0.97	1.03	0.99	ref

Table 4.10 (continued)

	Latent Status				
	Non-drinkers + non-drinking friends	Non-drinkers + 2 drinking friends	Experimenters + 4 drinking friends	Drinkers + 2 drinking friends	Drinkers + 4 drinking friends
Effect of Proportion of drinkers in the classroom (%) on probability of transitioning to... Conditional on Grade 7 latent status			*... Grade 8 latent status*		
Non-drinkers + non-drinking friends	ref	1.03	1.02	1.08	1.05
Non-drinkers + 2 drinking friends	0.98	ref	0.95[a]	0.97[a]	0.98[a]
Experimenters + 4 drinking friends	0.99	1.00	ref	0.98	1.01
Drinkers + 2 drinking friends	1.06	1.00	0.96	ref	1.00
Drinkers + 4 drinking friends	0.98	1.02	1.00	0.99	ref
	Non-drinkers + non-drinking friends	Non-drinkers + 2 drinking friends	Experimenters + 4 drinking friends	Drinkers + 2 drinking friends	Drinkers + 4 drinking friends
Effect of Opportunities for prosocial involvement at school on probability of transitioning to... Conditional on Grade 7 latent status			*... Grade 8 latent status*		
Non-drinkers + non-drinking friends	ref	0.96	1.21	0.99	0.95
Non-drinkers + 2 drinking friends	1.02	ref	1.08[a]	1.13[a]	0.97[a]
Experimenters + 4 drinking friends	0.99	0.98	ref	1.03	0.99
Drinkers + 2 drinking friends	1.00	0.98	1.01	ref	1.02
Drinkers + 4 drinking friends	0.95	0.96	1.05	0.99	ref

ℓ = -4478.83.

Note. All covariates entered simultaneously as predictors of Grade 7 to Grade 8 transitions.

[1]Diagonal element of the transition matrix served as the reference category. [a]Peer influence transitions.

4.4.2.2.1 *Pubertal timing*

This covariate appeared to moderate a number of transitions that were congruent with peer influence. This was evident in the "non-drinkers with 2 drinking friends" latent peer status in Grade 7 where early maturers were more likely than late/on-time maturing individuals to transition to the experimenters with three or four friends (*OR* = 1.17), current drinkers who had one or two friends (*OR* = 1.10) or more drinking friends (*OR* = 1.11) groups one year later.

4.4.2.2.2 *Family history of antisocial behaviour*

The odds of making transitions congruent with peer influence were about the same for individuals at all levels of this predictor. Seventh graders who were non-drinkers and had one or two drinking close friends had the same odds of transitioning into the "drinkers with 2 drinking friends and "drinkers with 4 drinking friends" (*OR* = 1.00 for both transitions), and "experimenters with 4 drinking friends" (*OR* = 1.04) latent peer statuses in Grade 8 relative to those who did not transition during the year. Nonetheless, the effect of *Family history of antisocial behaviour* was more prominent on transitions made by 7th graders in the latent peer subgroup of non-drinkers who did not have any drinking close friends. A one standard deviation increase in the predictor raised the odds that these non-drinkers would transition into the "experimenters with 4 drinking friends" and the "drinkers with 4 drinking friends" latent peer statuses by 29% in Grade 8. These non-drinkers in Grade 7 were also more likely to become current drinkers who had one or two drinking close friends relative to those who remained in the same latent status one year later (*OR* = 1.14).

4.4.2.2.3 *Proportion of drinkers in the classroom*

For 7th graders who started as non-drinkers and had one or two drinking close friends, they had decreased odds of transitioning into the "experimenters

with 4 drinking friends" latent peer status with one unit increase in this predictor, in relation to those who stayed in the same latent status one year later (*OR* = 0.95; peer influence process). However, this same latent subgroup of non-drinkers in Grade 7 had about the same odds of transitioning into the "drinkers with 2 drinking friends" (*OR* = 0.97) and the "drinker with 4 drinking friends" (*OR* = 0.98) latent statuses at all levels of the risk factor one year later (both peer influence transitions). Furthermore, the covariate increased the risk that Grade 7 non-drinkers with non-drinking peers would transition in Grade 8 to the group of drinkers with one or two drinking friends (*OR* = 1.08). There was a small unexpected effect in increasing the likelihood that Grade 7 drinkers with one or two drinking friends would transition to the Grade 8 non-drinkers with no drinking friends group (*OR* = 1.06).

4.4.2.2.4 ***Opportunities for prosocial involvement at school***

This covariate was found to moderate transitions over time in Washington State only and was unexpectedly found to be associated with increased risk. One standard deviation elevated level in the *Opportunities for prosocial involvement at school* was associated with increased odds in two peer influence transitions from being in the "non-drinkers with 2 drinking friends" latent status in Grade 7: The odds of transitioning into the "experimenters with 4 drinking friends" and the "drinkers with 2 drinking friends" latent statuses raised by 8% and 13 % respectively, relative to those who remained in the same latent status one year later. Nevertheless, the odds of transitioning into the "drinkers with 4 drinking friends" latent status in Grade 7 from being in the "non-drinkers with 2 drinking friends" latent status in the previous year (*OR* = 0.97; peer influence process) were about the same for individuals at all levels of the predictor.

4.5 Summary

Five-latent-status models were found to best represent peer group characteristics for both Victoria and Washington State samples with one latent status difference. Similar to the youngest cohort, alcohol-using rates were more prevalent among Grades 7 and 8 students (thirteen and fourteen year-olds) in Victoria compared to their same age counterparts in Washington State. Transitions congruent with reverse peer influence and peer selection processes were only evident in Victoria, affecting respectively 2% and 9% of the sample in that state. Further, peer influence processes were more common in Washington State in that three peer influence transitions were evident in Washington State whereas only two such transitions were found in Victoria, affecting similar numbers in both states (Victoria 6%; Washington State 8%).

Family history of antisocial behaviour, *Poor family management*, and *Parental attitudes favourable towards drug use* were found to be predictors of membership in latent peer subgroups in Grade 7 in both states. In addition, *Proportion of drinkers in the classroom* and *Family conflict* statistically significantly predicted latent status membership in Grade 7 in Washington State only.

Regarding prospective transitions between latent peer statuses, *Pubertal timing*, *Family history of antisocial behaviour*, and *Proportion of drinkers in the classroom* were found to be statistically significant predictors over time in both states. In addition, *Family conflict* and *Opportunities for* p*rosocial involvement at school* predicted transitions between latent peer subgroups over time in Victoria and Washington State respectively. *Family history of antisocial behaviour* was found be the only covariate that predicted membership in latent statuses cross-sectionally in Grade 7, as well as transitions over time between latent statuses in both states. Moreover, *Proportion of drinkers in the classroom* statistically significantly predicted the Grade 7 latent status memberships cross-sectionally and prospective transitions in Washington State only. Early pubertal timing

increased the risk of peer influence transitions in both Victoria and Washington State. *Opportunities for* p*rosocial involvement at school* was unexpectedly found to increase the risk of peer influence transitions in Washington State.

Chapter Five: Results for the oldest cohort – Grades 9 and 10

This chapter presents results from the oldest cohort where participants were first surveyed when they were in Grade 9 and were followed up again in Grade 10. General trends in drinking rates and the proportion of adolescents endorsing each of the observed binary indicators in both states are presented first. Next, fit statistics of competing models and the full set of parameter estimates of the final LTA models are presented. Peer group patterns and characteristics, as well as the incidence of transitioning between latent peer subgroups over time are described. These sections are then followed by results of a series of hypothesis tests to identify statistically significant covariates for predicting Grade 9 membership and prospective transitions. Similar to the middle cohort, the same set of covariates were incorporated in the final LTA models in both states for this cohort. Results from Victoria are presented first followed by results from Washington State. The chapter ends with a summary of findings both cross-sectionally and prospectively in each state.

The sample size and proportion endorsing the eight observed binary indicators in both states are shown in Table 5.1. The majority of participants had close friends who used alcohol by Grade 9 in both states; only 20% of Victoria and 30% of Washington 9th graders reported having no best friends who used alcohol. The proportion of those who reported having no drinking close friends decreased to 11% and 21% respectively for Victoria and Washington State by Grade 10. Again in this cohort, alcohol-using rates are more prevalent among Victorian youth. Most adolescents had tried alcohol in their lifetime in Victoria (82%) in Grade 9, 26% more than adolescents in the same grade level in Washington State (56%). By Grade 10, 82% of Victorian youth had used alcohol in the past year, compared to 52% of their counterparts in Washington State. Fifty-four percent of 9th graders and 69% of 10th graders consumed alcohol in the past 30 days prior to the interviews in Victoria and the proportions were almost double that of the same-age adolescents in Washington State (25% in Grade 9;

34% in Grade 10). Furthermore, a higher percentage of Victorian adolescents reported having binge drank in the past two weeks prior to the surveys (28% in Grade 9; 42% in Grade 10), compared to their counterparts in Washington State (11% in Grade 9; 17% in Grade 10).

Table 5.1
Observed sample size and proportion endorsing the eight binary indicators of self and peers drinking statuses for the oldest cohorts.

	Grade 9		Grade 10	
Binary indicators	*N*	Proportion (%)	*N*	Proportion (%)
		Victoria		
No drinking friends	187	20	103	11
1 to 2 drinking friends	260	27	196	21
3 to 4 drinking friends	508	53	645	68
Drink if friend offered at party	520	54	601	64
Be seen as cool if drink regularly	840	88	866	92
Bingeing during the past 2 weeks	266	28	397	42
Past 30 day alcohol use	515	54	651	69
Past year alcohol use	*	*	772	82
Lifetime alcohol use	779	82	*	*
		Washington State		
No drinking friends	291	30	201	21
1 to 2 drinking friends	347	36	334	35
3 to 4 drinking friends	334	34	430	45
Drink if friend offered at party	275	28	318	33
Be seen as cool if drink regularly	642	66	727	76
Bingeing during the past 2 weeks	104	11	167	17
Past 30 day alcohol use	240	25	327	34
Past year alcohol use	*	*	499	52
Lifetime alcohol use	548	56	*	*

*Not used in the respective wave.

A high endorsement was evident in the item asking adolescents if they would be seen as cool if they started drinking regularly, possibly due to high drinking rates in this age group. Most Victorian adolescents endorsed this item (88% in Grade 9; 92% in Grade 10) while in Washington State a high proportion of youth also reported "yes" to this item (66% in Grade 9; 76% in Grade 10). In Grade 9, over half of adolescents in Victoria (54%) reported that they would

accept alcoholic drinks offered by friends at parties and the proportion increased by 10% one year later. Whereas the proportions of adolescents in Washington State reporting "yes" to the same item were 28% and 33% respectively in Grades 9 and 10, which was relatively low compared to their Victorian counterparts.

5.1 Model selection among competing models

A series of LTA models with two to six latent statuses were run to identify the best fit model. Table 5.2 depicts the model fit information of fitting LTA models ranging from two to six latent statuses in both states. Although the six-latent-status model in both states had the lowest AIC and BIC values among other models, the five-latent-status model was chosen after examination and comparison of the latent status profile of both models. The latent status profile of the five-status models demonstrated good latent class separation and homogeneity in both states. Also a model with five latent statuses was considered to be more parsimonious for subsequent analyses incorporating covariates. Naming and interpretation of latent statuses were completed as outlined in Section 3.2.

Table 5.2
Model fit information of fitting LTA models with two to six latent statuses for the oldest cohort by state.

Number of latent statuses	G^2*	*df*	AIC	BIC	Log-likelihood
			Victoria		
2	4073.99	65516	4111.99	4204.48	-6720.77
3	2960.53	65503	3024.52	3180.30	-6164.04
4	2144.09	65488	2238.09	2466.88	-5755.82
5	**1713.30**	**65471**	**1841.30**	**2152.85**	**-5540.42**
6	1462.22	65452	1628.22	2032.26	-5414.88
			Washington State		
2	4732.58	65516	4770.58	4863.35	-7574.39
3	3011.28	65503	3075.28	3231.52	-6713.75
4	2157.51	65488	2251.51	2480.98	-6286.86
5	**1682.47**	**65471**	**1810.47**	**2122.94**	**-6049.34**
6	1526.40	65452	1692.40	2097.64	-5971.30

**p*-values not reported because the degrees of freedom are too large.

The hypothesis test of measurement invariance was conducted for the five-latent status models. For Victoria, the model with item-response probabilities constrained to be equal across time (G^2 = 1713.30 with 65471 *df*) was compared to one with item-response probabilities estimated freely (G^2 = 1659.90 with 65431 *df*). The difference G^2 of 53.40 was compared to a χ^2 table with *df* equal to 40 yielding a *p*-value of 0.08. This non-significance *p*-value indicates that the underlying structure did not differ across time. For Washington State, the model with item-response probabilities constrained to be equal across time (G^2 = 1682.47 with 65471 *df*) was compared to one with item-response probabilities estimated freely (G^2 = 1606.99 with 65431 *df*). The difference G^2 of 75.48 was compared to a χ^2 table with *df* equal to 40 yielding a *p*-value < 0.001. This non-significance *p*-value indicate that the underlying structures of drinking behaviour differ across time. Upon close inspection of the item-response probabilities of the freely estimated model, none of the probabilities changed substantially that warrant different labelling of the latent peer statuses in Grade 10. Thus, item-

response probabilities were constrained to be equal across time in the final LTA model in both states.

5.2 Peer group patterns and characteristics

5.2.1 Final LTA model for Victoria

A five-latent-status model was found to best capture the heterogeneity of peer drinking groups among Victorian adolescents in Grades 9 and 10. The latent status profile consists of one latent subgroup each of non-drinkers, drinkers, and binge drinkers, and two latent subgroups of experimenters as can be seen in Table 5.3. The first latent status was characterised by a high probability of having one or two close friends who drank (probability = 1.00) and a low probability of drinking in their lifetime (probability = 0.39) and in the past 30 days (probability = 0.04). This latent status was labelled "non-drinkers with 2 drinking friends". The second latent status subgroup, which was labelled "experimenters with non-drinking friends", consisted of experimenters who were likely to have tried alcohol in their lifetime (probability = 0.52) and had no drinking close friends (probability = 1.00) but had a low probability of having tried alcohol in the past 30 days (probability = 0.23). Similar to the second latent status, the third latent status also contained experimenters but this subgroup of individuals was almost certain to have had three or four drinking close friends (probability = 1.00). The label for this latent status was "experimenters with 4 drinking friends".

Table.5.3

Five-Latent-Status Model of self-report drinking statuses of adolescents and their peers in Grades 9 and 10 in Victoria (N = 961).

	Latent Status				
	Non-drinkers + 2 drinking friends	Experimenters + non-drinking friends	Experimenters + 4 drinking friends	Drinkers + 2 drinking friends	Binge drinkers + 4 drinking friends
Item-response probabilities of a "Yes" response (G9 & G10)*					
No drinking friends	0.0000	**1.0000**	0.0000	0.0876	0.0000
1 to 2 drinking friends	**1.0000**[†]	0.0000	0.0000	**0.9124**	0.0000
3 to 4 drinking friends	0.0000	0.0000	**1.0000**	0.0000	**1.0000**
Drink if friend offered at party	0.0646	0.1553	0.3475	**0.7141**	**0.9261**
Be seen as cool if drink regularly	**0.7790**	**0.7729**	**0.8795**	**0.9474**	**0.9670**
Bingeing during the past 2 weeks	0.0052	0.0584	0.0382	0.2981	**0.6935**
Past 30 day alcohol use	0.0425	0.2305	0.2960	**0.7145**	**1.0000**
Lifetime alcohol use (Past year alcohol use in G10)[1]	0.3873	**0.5208**	**0.7714**	**0.9704**	**0.9962**
Prevalence of latent status					
Grade 9 (G9)	12%	20%	20%	16%	33%
Grade 10 (G10)	8%	11%	17%	13%	51%
Probability of transitioning to ... Conditional on G9 latent status			*...G10 latent status*		
Non-drinkers + 2 drinking friends	**0.25**[‡]	0.22	0.35[a]	0.10[a]	0.08[a]
Experimenters + non-drinking friends	0.19	**0.31**	0.14[b]	0.19[b]	0.17[b]
Experimenters + 4 drinking friends	0.06	0.05	**0.39**	0.09	0.42
Drinkers + 2 drinking friends	0.00	0.06	0.07	**0.28**	0.59
Binge drinkers + 4 drinking friends	0.00	0.01	0.05	0.05	**0.89**

ℓ = -5540.43.

*Item-response probabilities constrained to be equal across times. [†]Item-response probabilities > 0.5 in bold to facilitate interpretation.

[1]Alcohol use indicator used in Grade 10. [‡]Diagonal transition probabilities in bold in bottom rows to facilitate interpretation.

[a]Peer influence transitions. [b]Peer selection transitions.

Individuals who were assigned to the fourth latent peer subgroup were current drinkers who had a high probability of having consumed alcohol in their lifetime and in the past 30 days (probability = 0.97 and 0.71 respectively) and had one or two drinking best friends (probability = 0.91). This latent status was named "drinkers with 2 drinking friends". The fifth latent status was characterised by binge drinkers who had a very high probability of drinking in their lifetime (probability = 1.00), in the past 30 days (probability = 1.00) and having had five alcoholic drinks or more in a row in the past two weeks (probability = 0.69). These individuals were also almost certain to have had three or four drinking close friends (probability = 1.00). Thus, the label for this latent status was "binge drinkers with 4 drinking friends".

Most adolescents, even those who had not started drinking, had a high chance of regarding drinking regularly as being seen as cool (chances ranged from 77% among experimenters to 97% among binge drinkers) by Grade 9. In addition, only those individuals who were current drinkers or binge drinkers and associated with drinking close friends would accept alcoholic drinks offered by friends at parties (probabilities = 0.71 and 0.93 respectively for current drinkers and binge drinkers).

According to the middle rows of Table.5.3, the latent status with the highest prevalence was the "binge drinkers with 4 drinking friends" latent status in Grade 9 (33%). There was a substantial increase in the proportion of this latent status one year later compared to other latent statuses; the proportion of 10^{th} graders who were classified as binge drinkers and had three or four drinking close friends increased by 18% (prevalence = 51%). Only 12% of 15 year-olds were classified as non-drinkers and they had one or two best friends who used alcohol in Grade 9. By Grade 10, the proportion of this latent status decreased further to 8%.

5.2.2 Final LTA model in Washington State

The heterogeneity of peer subgroups among 9th and 10th graders in Washington State was also best explained by a five-latent-status model. The full set of parameter estimates of the final LTA model is shown in Table 5.4. This latent status profile consists of two subgroups of non-drinkers, one subgroup for each of experimenters, current drinkers, and binge drinkers. The first latent status contained individuals who had a low probability of having tried alcohol in their lifetime (probability = 0.20) and in the past 30 days (probability = 0.05), but they were almost certain to have had non-drinking close friends (probability = 1.00). This latent peer subgroup is labelled "non-drinkers with non-drinking friends". The second latent status also contained non-drinkers and had one to two close friends who drank (probability = 1.00). Therefore, this latent peer subgroup was named "non-drinkers with 2 drinking friends". Individuals who had a high chance of using alcohol in their lifetime (59%) but not in the past 30 days (11%) and were almost certain to have had three or four drinking close friends (probability = 1.00) were assigned to the third latent status which was called "experimenters with 4 drinking friends".

The fourth latent status was characterised with individuals who had a high probability of using alcohol in the past 30 days (probability = 0.70) and in their lifetime (probability = 0.97), and having had one or two drinking close friends (probability = 1.00). This latent status was named "drinkers with 2 drinking friends". The fifth latent peer subgroup consisted of individuals who had high probabilities of consuming alcohol in their lifetime (probability = 1.00) and in the past 30 days (probability = 0.96), as well as having had five alcoholic drinks in a row in the past two weeks (probability = 0.60) and having had three or four close friends who drank (probability = 1.00). The label for this latent peer subgroup was "binge drinkers with 4 drinking friends".

Table 5.4

Five-Latent-Status Model of self-report drinking statuses of adolescents and their peers in Grades 9 and 10 in Washington State (N = 975).

	Latent Status				
	Non-drinkers + non-drinking friends	Non-drinkers + 2 drinking friends	Experimenters + 4 drinking friends	Drinkers + 2 drinking friends	Binge drinkers + 4 drinking friends
Item-response probabilities of a "Yes" response (G9 & G10)*					
No drinking friends	**1.0000**[†]	0.0000	0.0000	0.0000	0.0026
1 to 2 drinking friends	0.0000	**1.0000**	0.0000	**1.0000**	0.0000
3 to 4 drinking friends	0.0000	0.0000	**1.0000**	0.0000	**0.9974**
Drink if friend offered at party	0.0286	0.0886	0.2722	**0.5363**	**0.8719**
Be seen as cool if drink regularly	**0.5399**	**0.6478**	**0.7643**	**0.8120**	**0.8994**
Bingeing during the past 2 weeks	0.0042	0.0000	0.0085	0.2141	**0.5956**
Past 30 day alcohol use	0.0477	0.0099	0.1149	**0.6953**	**0.9632**
Lifetime alcohol use (Past year alcohol use in G10)[1]	0.2031	0.3171	**0.5919**	**0.9674**	**0.9970**
Prevalence of latent status					
Grade 9 (G9)	30%	26%	19%	10%	16%
Grade 10 (G10)	21%	25%	21%	10%	23%
Probability of transitioning to ... Conditional on G9 latent status			*...G10 latent status*		
Non-drinkers + non-drinking friends	**0.48**[‡]	0.30	0.13	0.04	0.04
Non-drinkers + 2 drinking friends	0.15	**0.38**	0.31[a]	0.08[a]	0.08[a]
Experimenters + 4 drinking friends	0.11	0.24	**0.36**	0.05	0.25
Drinkers + 2 drinking friends	0.04	0.14	0.12	**0.28**	0.42
Binge drinkers + 4 drinking friends	0.01	0.02	0.10	0.17	**0.69**

ℓ = -6049.34.

*Item-response probabilities constrained to be equal across times. [†]Item-response probabilities > 0.5 in bold to facilitate interpretation.

[1]Alcohol use indicators used in Grade 10. [‡]Diagonal transition probabilities in bold in bottom rows to facilitate interpretation.

[a]Peer influence transition

By Grades 9 and 10, it was common for the majority to think that they would be seen as cool if they started using alcohol regularly (probabilities ranged from 0.54 for non-drinkers who had no drinking friends to 0.90 for binge drinkers). Only those who were current drinkers or binge drinkers and associated with drinking close friends would accept alcoholic drinkers being offered by friends at parties (probabilities = 0.54 and 0.87 for current drinkers and binge drinkers respectively).

The prevalence of each latent status is presented in the middle rows of Table 5.4. In Grade 9, the most common latent status was the "non-drinkers with non-drinking friends" latent status (30%), followed by the latent peer subgroup of non-drinkers who had one or two drinking best friends (26%). By Grade 10 the "non-drinkers with 2 drinking friends" latent status became the most prevalent (25%) and the second most common latent status was the "binge drinkers with 4 drinking friends" latent peer subgroup (23%).

5.2.3 Similarities and differences between states

Peer group drinking patterns were best represented by a five-status LTA model in both states but with one latent status difference. There was a subgroup who had started experimenting with alcohol on their own without drinking close friends in Victoria, whereas in Washington State the different latent peer subgroup consisted of non-drinkers who had non-drinking close friends in Grades 9 and 10. Although there were four latent statuses which were similar in both states, the prevalences in the latent statuses were different. In particular, there were only 12% and 8% of non-drinkers in Grades 9 and 10 respectively in Victoria, compared to 56% and 46% of non-drinkers with or without drinking close friends in Grades 9 and 10 respectively in Washington State. Additionally, the proportion of Victorian binge drinkers (33% in Grade 9 and 51% in Grade 10) was more than double that of their Washington counterparts (16% in Grade 9 and 23% in Grade 10). Moreover, only those who were currently drinking and having drinking best

friends would accept alcoholic drinks offered by their friends at a party in both states. By Grade 9, most adolescents including those who had not started using alcohol thought they would be seen as cool if they started drinking regularly in both states.

5.3 Movements between peer subgroups over time

5.3.1 Transitions over time in Victoria

The bottom rows of Table.5.3 present the transition probabilities between latent statuses from Grade 9 to 10 in Victoria. The "binge drinkers with 4 drinking friends" displayed the highest stability out of all the other latent peer statuses. Among 9th graders who were already binge drinkers and had three or four drinking close friends, they had an 89% chance of staying in the same latent status one year later. The probabilities for this latent subgroup of 15-year-old binge drinkers to revert to less risky latent statuses in Grade 10 were very low (probabilities ranged from 0 to 0.05). Further, 9th graders who were non-drinkers and had one or two drinking best friends had a 25% chance of being stable as non-drinkers with similar peers one year later. For those in the same latent status of non-drinkers who made transitions, they were most likely to become experimenters with three or four drinking best friends in Grade 10 (probability = 0.35; peer influence transition). The probabilities for 9th graders in the "non-drinkers with 2 drinking friends" latent status to transition to the "drinkers with 2 drinking friends" and "binge drinkers with 4 drinking friends" latent subgroups in Grade 10 were 0.10 and 0.08 respectively. These transitions were also congruent with peer influence processes.

Moreover, for those who had experimented with alcohol but did not have any drinking close friends in Grade 9, they had a 31% chance of staying in the same latent peer subgroup one year later. Among these experimenters who made transitions, they were most likely to transition to either the "non-drinkers with 2

drinking friends" or "drinkers with 2 drinking friends" latent statuses (probability = 0.19 for both). In particular, the transition to becoming current drinkers who had one or two drinking best friends was congruent with peer selection processes. Other transitions that were congruent with peer selection were from the "experimenters with non-drinking friends" latent status in Grade 9 to acquiring three or four drinking peers but remaining as experimenters (probability = 0.14), and to becoming binge drinkers who had three or four drinking best friends in Grade 10 (probability = 0.17).

Additionally, for 9th graders who belong to the "experimenters with 4 drinking friends" latent status, the probability for them to stay in the same latent peer subgroup one year later was 0.39. Among these experimenters who made transitions, they were most likely to transition into the "binge drinkers with 4 drinking friends" latent status (probability = 0.42). Further, for individuals who were classified as current drinkers who had one or two drinking best friends in Grade 9, they have a 28% chance of staying in the same latent status one year later. Ninth graders in this latent subgroup of current drinkers in Grade 9 were most likely to transition to being in the "binge drinkers with 4 drinking friends" latent statuses in Grade 10 (probability = 0.59). The probabilities for these current drinkers to revert to being in less risky latent statuses in Grade 10 were very low (probabilities ranged from 0 to 0.07).

5.3.2 Transition over time in Washington State

The probabilities of transitioning between latent statuses from Grade 9 to 10 in Washington State are shown in the bottom rows of Table 5.4. Similar to the Victorian sample, the "binge drinkers with 4 drinking friends" latent status showed the highest stability in that this group of 9th graders had a 69% chance of staying as binge drinkers one year later. If these binge drinkers were to make transitions, they were most likely to revert to being current drinkers who had fewer close friends who drank (probability = 0.17). The probabilities for this

subgroup of binge drinkers to transition to less risky latent statuses one year later were low (probabilities ranged from 0.01 to 0.10). Moreover, the second most stable latent status was non-drinkers who did not have any drinking close friends in Grade 9. These non-drinkers had a 48% chance of remaining in the same latent peer subgroup one year later. For those non-drinkers in this group who made transitions, they were most likely to transition into the "non-drinkers with 2 drinking friends" latent status one year later (probability = 0.30).

Ninth graders in the "non-drinkers with 2 drinking friends" latent status had a probability 0.38 of staying in the same latent peer subgroup in Grade 10. If these non-drinkers were to make transitions, they were most likely to transition into the "experimenters with 4 drinking friends" latent status one year later (probability = 0.31), which was congruent with peer influence. Other transitions that were congruent with peer influence observed among this latent subgroup of non-drinkers were the transitions into the "drinkers with 2 drinking friends" and the "binge drinkers with 4 drinking friends" latent statuses in Grade 10 (probability = 0.08 for both).

The probability of staying in the same latent status one year later for 9th graders who were experimenters and had three or four drinking close friends was 0.36. If these experimenters were to make transitions, they were most likely to become binge drinkers who had the same number of drinking peers in Grade 10 (probability = 0.25). In addition, for current drinkers who had one or two drinking best friends in Grade 9, they had a 28% chance of remaining in the same latent peer subgroup one year later. They were also most likely to transition to being binge drinkers who had acquired more drinking peers in Grade 10 (probability = 0.42). The probabilities for this subgroup of current drinkers to transitioning into less risky latent statuses was low (probabilities ranged from 0.04 to 0.14).

5.4 Effect of covariates

The same set of covariates which was tested in the Grade 7 and 8 cohort was again tested in this cohort in both states. Table 5.5 presents results of hypothesis tests for Grade 9 predictors of membership in Grade 9 latent statuses by state. Three covariates were found to predict latent status membership in Grade 9 for both states: *Family history of antisocial behaviour* ($p < 0.001$ for both states), *Poor family management* ($p = 0.003$ for Victoria; $p < 0.001$ for Washington State), and *Parental attitudes favourable towards drug use* ($p < 0.001$ for both states). In addition, *Proportion of drinkers in classroom* ($p < 0.001$) was found to be a statistically significant predictor for latent status membership in Grade 9 in Victoria only.

For predicting transitions over time, the LTA model for Victoria was not identified when all 10 covariates were included. This may be due to three transitions in the final LTA model which had transition probabilities of zero or near zero (see Table 5.3) and also LTA models cannot account for missing data on covariates (Collins & Lanza, 2010). Based on results of hypothesis tests predicting Grade 9 latent status memberships (see Table 5.5), the effect of *Gender* and *Involvement in clubs* did not reach statistical significance thus these covariates were not included in the final LTA model in Victoria. The effect of *Proportion of drinkers in the classroom* was tested in an LTA model with 6 covariates which did not reach statistical significance hence this covariate was also dropped from the analysis in order to identify the LTA model with 7 covariates. Table 5.6 shows the results of the hypothesis tests of predictors for transitions between latent statuses from Grade 9 to 10 by state. *Pubertal timing* ($p < 0.001$ for both states) and *Family history of antisocial behaviour* ($p < 0.001$ for both states) were found to be statistically significant predictors for both states. In addition, *Family conflict* ($p = 0.044$) and *Opportunities for prosocial involvement in the family* ($p = 0.001$) predicted prospective transitions only in Victoria.

Table 5.5
Hypothesis tests for predictors of Grade 9 latent status membership by state.

Covariate	ℓ Removing Covariate (ℓ_1)	Likelihood-ratio Statistic*	*df*	*p*-value
		Victoria		
Gender	-5092.29	6.35	4	0.174
Pubertal timing	-5950.88	3.54	4	0.472
Proportion of drinkers in the classroom (%)	-5098.81	19.40	4	**<0.001**
Family history of antisocial behaviour	-5148.45	118.66	4	**<0.001**
Poor family management	-5097.17	16.11	4	**0.003**
Family conflict	-5090.00	1.77	4	0.778
Parental attitudes favourable towards drug use	-5125.67	73.11	4	**<0.001**
Opportunities for prosocial involvement in the family	-5089.36	0.49	4	0.974
Opportunities for prosocial involvement at school	-5091.46	4.69	4	0.320
Involvement in clubs	-5091.49	4.76	4	0.313
		Washington State		
Gender	-5270.09	0.09	4	0.998
Pubertal timing	-5271.12	2.14	4	0.711
Proportion of drinkers in the classroom (%)	-5273.83	7.57	4	0.108
Family history of antisocial behaviour	-5334.16	128.21	4	**<0.001**
Poor family management	-5285.32	30.54	4	**<0.001**
Family conflict	-5271.10	2.10	4	0.716
Parental attitudes favourable towards drug use	-5285.20	30.30	4	**<0.001**
Opportunities for prosocial involvement in the family	-5271.39	2.69	4	0.610
Opportunities for prosocial involvement at school	-5271.88	3.67	4	0.452
Involvement in clubs	-5272.08	4.07	4	0.397

*Calculated using $-2(\ell_1 - \ell_2)$. Victoria $\ell_2 = -5089.12$. Washington State $\ell_2 = -5270.05$. *p*-values of statistically significant covariates are highlighted in bold.
Note. All covariates entered simultaneously as predictors of Grade 9 latent status membership

Table 5.6
Hypothesis tests for predictors of transitions between latent peer statuses in Grades 9 and 10 by state.

Covariates	ℓ Removing Covariate (ℓ_1)	Likelihood-ratio Statistic*	*df*	*p*-value
		Victoria†		
Pubertal timing	-5339.59	95.96	20	**<0.001**
Family history of antisocial behaviour	-5355.90	128.58	20	**<0.001**
Poor family management	-5292.89	2.56	20	0.999
Family conflict	-5307.59	31.96	20	**0.044**
Parental attitudes favourable towards drug use	-5294.97	6.72	20	0.998
Opportunities of prosocial involvement in the family	-5313.66	44.10	20	**0.001**
Opportunities of prosocial involvement at school	-5299.45	15.68	20	0.736
		Washington State		
Gender	-5424.70	5.38	20	0.999
Pubertal timing	-5696.59	549.16	20	**<0.001**
Proportion of drinkers in classroom (%)	-5423.65	3.28	20	0.999
Family history of antisocial behaviour	-5510.97	177.92	20	**<0.001**
Poor family management	-5424.77	5.52	20	0.999
Family conflict	-5433.81	23.60	20	0.260
Parental attitudes favourable towards drug use	-5423.69	3.36	20	0.999
Opportunities for prosocial involvement in the family	-5424.37	4.72	20	0.999
Opportunities for prosocial involvement at school	-5430.63	17.24	20	0.637
Involvement in clubs	-5424.47	4.92	20	0.999

*****Calculated using $-2(\ell_1 - \ell_2)$. Victoria $\ell_2 = -5291.61$. Washington State $\ell_2 = -5422.01$.
p-values of statistically significant covariates are highlighted in bold.
Note. All covariates entered simultaneously as predictors of Grade 9 latent status membership.
†The LTA model including all ten covariates was not identified. *Gender*, *Involvement in clubs*, and *Proportion of drinkers in the classroom* were not included in order to identify the LTA model with 7 covariates.

5.4.1 Predicting Grade 9 latent status membership

The effect of statistically significant covariates predicting Grade 9 latent status membership in regression coefficients and odds ratios are shown in Table 5.7 and 5.8 for Victoria and Washington State respectively. The reference category was the "non-drinkers with 2 drinking friends" latent status in Victoria and the "non-drinkers with non-drinking friends" latent status in Washington State. All covariates were entered simultaneously as predictors of Grade 9 latent status membership. The interpretation of odds ratios is the same as outlined in Section 3.5.1.

5.4.1.1 Effect of covariates in Victoria

According to Table 5.7, a one standard deviation increase in *Family history of antisocial behaviour* was associated with elevated odds of being in all the riskier latent statuses (*OR*s ranged from 1.66 to 3.80), except being in the "experiments with non-drinking friends" latent status (*OR* = 0.77), relative to the reference latent status. Similar trends were observed for *Poor family management* in which a one-unit increase in this predictor raised the odds of being in all the riskier latent statuses (*OR*s ranged from 1.37 to 1.70) except being in the "experiments with non-drinking friends" latent status (*OR* = 0.90). Further, the increased odds of being in the riskier latent statuses ranged from 79% to 290% relative to the "non-drinkers with 2 drinking friends" latent status, with a one standard deviation increase in *Parental attitudes favourable towards drug use*. Additionally, an increase in *Proportion of drinkers in the classroom* was associated with decreased odds of being experimenters who had no drinking best friends (*OR* = 0.72), and being current drinkers who had one or two drinking best friends (*OR* = 0.97). Nevertheless, a one standard deviation increase in this predictor raised the odds of being in the "experimenters with 4 drinking friends" and the "binge drinkers with 4 drinking friends" latent statuses by 8% and 35% respectively.

Table 5.7
Regression coefficients and odds ratios of statistically significant predictors of membership in Grade 9 latent peer statuses in Victoria.

	Grade 9 Latent Status				
	Non-drinkers + 2 drinking friends	Experimenters + non-drinking friends	Experimenters + 4 drinking friends	Drinkers + 2 drinking friends	Binge drinkers + 4 drinking friends
Intercept					
Beta	ref[1]	0.23	0.65	0.15	0.22
Odds	ref	1.26	1.92	1.16	1.25
Family history of antisocial behaviour					
Beta	ref	-0.26	0.51	0.65	1.34
Odds Ratios	ref	0.77	1.66	1.91	3.80
Poor family management					
Beta	ref	-0.11	0.17	0.31	0.53
Odds Ratios	ref	0.90	1.19	1.37	1.70
Parental attitudes favourable towards drug use					
Beta	ref	0.58	0.71	1.13	1.36
Odds Ratios	ref	1.79	2.04	3.10	3.90
Proportion of drinkers in the classroom (%)					
Beta	ref	-0.32	0.08	-0.03	0.30
Odds Ratios	ref	0.72	1.08	0.97	1.35

ℓ = -5089.12.
Note. All covariates entered simultaneously as predictors of Grade 9 latent status membership.
[1]The "non-drinkers with 2 drinking friends" latent status served as the reference category in multinomial logistic regression analyses.

Table 5.8
Regression coefficients and odds ratios of statistically significant predictors of membership in Grade 9 latent peer statues in Washington State.

	Grade 9 Latent Status				
	Non-drinkers + non-drinking friends	Non-drinkers + 2 drinking friends	Experimenters + 4 drinking friends	Drinkers + 2 drinking friends	Binge drinkers + 4 drinking friends
Intercept					
Beta	ref[1]	0.07	0.15	-0.65	-0.64
Odds	ref	1.07	1.16	0.52	0.53
Family history of antisocial behaviour					
Beta	ref	0.56	1.14	1.12	1.51
Odds Ratios	ref	1.76	3.12	3.01	4.51
Poor family management					
Beta	ref	0.12	0.54	0.65	0.81
Odds Ratios	ref	1.13	1.72	1.91	2.25
Parental attitudes favourable towards drug use					
Beta	ref	-0.12	0.21	0.62	0.71
Odds Ratios	ref	0.89	1.24	1.86	2.04

ℓ = -5270.05.

Note. All covariates entered simultaneously as predictors of Grade 9 latent status membership.

[1]The "non-drinkers with non-drinking friends" latent status served as the reference category in multinomial logistic regression analyses.

5.4.1.2 Effect of covariates in Washington State

In general the risk factors had a similar effect in Washington State as in Victoria in increasing the probability of transitions to alcohol use and/ or to more alcohol-using peers. Referring to Table 5.8, a one standard deviation increase in *Family history of antisocial behaviour* was associated with an increased odds of being in all the riskier latent statuses, with odds ratios ranging from 1.76 (being non-drinkers who had one to two drinking best friends) to 4.51 (being binge drinkers who had three or four drinking peers) relative to the reference latent status. A similar trend was noted in *Poor family management* in that elevated levels in this predictor also raised the odds of being in all the riskier latent peer subgroups, with odds ratios ranging from 1.13 (being in the "non-drinkers with 2 drinking friends" latent status) to 2.25 (being in the "binge drinkers with 4 drinking friends" latent status). Further, a one standard deviation increase in *Parental attitudes favourable towards drug use* was associated with decreased odds of being non-drinkers who had one or two drinking close friends (*OR* = 0.89). However, the odds of being in the "experimenters with 4 drinking friends", the "drinkers with 2 drinking friends", and the "binge drinkers with 4 drinking friends" latent statuses were raised by 24%, 86%, and 104% respectively with a one-unit elevation in this predictor in relation to the reference latent status.

5.4.2 Predicting transitions over time

Table 5.9 and 5.10 depict the odds ratio for each statistically significant predictor of transitions from Grade 9 to Grade 10 latent statuses for Victoria and Washington State respectively. All covariates were entered simultaneously in the LTA models. The interpretation of odds ratios is the same as outlined in Section 3.5.2. The diagonal elements of the transition matrices served as the reference group in the multinomial logistic regressions for each row. All odds ratios are interpreted as the effect of the covariate on the odds of transitioning from a latent status at Time 1 to another latent status at Time 2 relative to being in the same

latent status at Time 2. Results presented in this section focus on transitions congruent with peer influence or selection processes.

5.4.2.1 Effect of covariates on transitions over time in Victoria

The effect of *Pubertal timing*, *Family history of antisocial behaviour*, *Family conflict*, and *Opportunities for prosocial behaviour in the family* are presented in Table 5.9.

5.4.2.1.1 ***Pubertal timing***

The moderating effect of *Pubertal timing* on peer influence transitions was observed among 9th graders in the "non-drinkers with 2 drinking friends" latent status. Among this latent subgroup of non-drinkers who were early developers in Grade 9, they were more likely to become experimenters who had three or four drinking best friends than late/on-time maturers one year later (*OR* = 1.05), in relation to those who did not make transitions. However, the odds of transitioning into the "drinkers with 2 drinking friends" and the "binge drinkers with 4 drinking friends" latent statuses (*OR* = 0.97 and 0.96 respectively; both peer influence transitions) in Grade 10 were about the same for early maturers and their late/on-time counterparts relative to the reference latent status.

Three potentially peer selection transitions were observed among the latent peer subgroup of experimenters who did not have any drinking best friends in Grade 9. Early maturers were 1.22 times more likely to transition into the "drinkers with 2 drinking friends" latent status compare to late/on-time maturing individuals in Grade 10. However, these early maturing experimenters in Grade 9 were less likely than their late/on-time counterparts to become binge drinkers who had three or four drinking best friends one year later (*OR* = 0.93). Further, early and late/on-time developers in Grade 9 had about the same odds of being in the "experimenters with 4 drinking friends" latent status (*OR* = 1.02) in relation to those who stayed in the same latent status one year later.

Table 5.9
Odds ratios of statistically significant predictors of transitions between latent peer statuses in Grades 9 and 10 in Victoria.

	Latent Status				
	Non-drinkers + 2 drinking friends	Experimenters + non-drinking friends	Experimenters + 4 drinking friends	Drinkers + 2 drinking friends	Binge drinkers + 4 drinking friends
Effect of Pubertal timing on probability of transitioning to...			*... Grade 10 latent status*		
Conditional on Grade 9 latent status					
Non-drinkers + 2 drinking friends	ref[l]	0.98	1.05[a]	0.97[a]	0.96[a]
Experimenters + non-drinking friends	0.91	ref	1.02[b]	1.22[b]	0.93[b]
Experimenters + 4 drinking friends	0.91	0.93	ref	1.04	0.91
Drinkers + 2 drinking friends	1.12	1.14	1.00	ref	0.98
Binge drinkers + 4 drinking friends	2.34	0.69	0.99	1.16	ref

	Non-drinkers + 2 drinking friends	Experimenters + non-drinking friends	Experimenters + 4 drinking friends	Drinkers + 2 drinking friends	Binge drinkers + 4 drinking friends
Effect of Family history of antisocial behaviour on probability of transitioning to...			*... Grade 10 latent status*		
Conditional on Grade 9 latent status					
Non-drinkers + 2 drinking friends	ref	0.93	0.96[a]	0.98[a]	0.96[a]
Experimenters + non-drinking friends	1.01	ref	1.08[b]	1.03[b]	1.08[b]
Experimenters + 4 drinking friends	1.05	1.09	ref	1.08	1.04
Drinkers + 2 drinking friends	1.05	1.11	1.06	ref	1.07
Binge drinkers + 4 drinking friends	1.44	1.22	0.90	1.03	ref

Table 5.9 (continued)

	Latent Status				
	Non-drinkers + 2 drinking friends	Experimenters + non-drinking friends	Experimenters + 4 drinking friends	Drinkers + 2 drinking friends	Binge drinkers + 4 drinking friends
Effect of Family conflict on probability of transitioning to...			*... Grade 10 latent status*		
Conditional on Grade 9 latent status					
Non-drinkers + 2 drinking friends	ref	1.00	0.97[a]	0.99[a]	1.01[a]
Experimenters + non-drinking friends	1.00	ref	1.01[b]	1.04[b]	0.96[b]
Experimenters + 4 drinking friends	0.99	0.99	ref	0.92	0.99
Drinkers + 2 drinking friends	0.99	0.95	1.03	ref	0.98
Binge drinkers + 4 drinking friends	0.78	0.80	1.01	0.88	ref
	Non-drinkers + 2 drinking friends	Experimenters + non-drinking friends	Experimenters + 4 drinking friends	Drinkers + 2 drinking friends	Binge drinkers + 4 drinking friends
Effect of Opportunities for prosocial involvement in the family on probability of transitioning to...			*... Grade 10 latent status*		
Conditional on Grade 9 latent status					
Non-drinkers + 2 drinking friends	ref	0.98	0.98[a]	0.98[a]	1.05[a]
Experimenters + non-drinking friends	1.00	ref	1.02[b]	1.03[b]	0.91[b]
Experimenters + 4 drinking friends	1.07	0.99	ref	0.95	0.94
Drinkers + 2 drinking friends	1.04	0.92	1.06	ref	1.03
Binge drinkers + 4 drinking friends	1.33	1.26	0.97	0.97	ref

ℓ = -5291.61. *Note*. All covariates entered simultaneously as predictors of Grade 9 to Grade 10 transitions.
[1]Diagonal element of the transition matrix served as the reference category.
[a]Peer influence transitions. [b]Peer selection transition.

5.4.2.1.2 *Family history of antisocial behaviour*

The moderating effect of this predictor on potentially peer influence transitions observed in the "non-drinkers with 2 drinking friends" latent status were about the same for individuals at all levels of the predictor. In particular, the odds ratios for this latent subgroup of non-drinking 9th graders to transition into the "experimenters with 4 drinking friends", the "drinkers with 2 drinking friends", and the "binge drinkers with 4 drinking friends" latent statuses one year later were 0.96, 0.98, and 0.96 respectively. For the effect on transitions congruent with peer selection, elevated levels on *Family history of antisocial behaviour* raised the odds of transitioning into the "experimenters with 4 drinking friends" and the "binge drinkers with 4 drinking friends" latent statuses by 8% in Grade 10, from being experimenters who did not have any drinking close friends in the previous year. The odds for 9th graders in the "experimenters with non-drinking friends" latent status to transition to the current drinkers who had one or two drinking best friends in Grade 10 were about the same for individuals at all levels in the predictor (*OR* = 1.03; peer selection process).

5.4.2.1.3 *Family conflict*

This risk factor was found to be statistically significant only in the Victorian sample. The odds of transitioning from being non-drinkers who had one or two drinking friends in Grade 9 to being in the "experimenters with 4 drinking friends" (*OR* = 0.97), the "drinkers with 2 drinking friends" (*OR* = 0.99), and the "binge drinkers with 4 drinking friends" (*OR* = 1.01) latent statuses one year later were about the same for individuals at all levels of *Family conflict* (all peer influence transitions). Similarly, the moderating effect of this predictor was rather small on transitions motivated by peer selection process. In particular, the odds of transitioning from being experimenters who had non-drinking best friends in Grade 9 to being in the "experimenters with 4 drinking friends" (*OR* = 1.01), the "drinkers with 2 drinking friends" (*OR* = 1.04), and the "binge drinkers with 4 drinking

friends" (*OR* = 0.96) latent statuses in Grade 10 were about the same for individuals at all levels of *Family conflict*.

5.4.2.1.4 ***Opportunities for prosocial involvement in the family***

Again, this predictor was found to be statistically significant in the Victorian sample only. A one standard deviation increase in *Opportunities for prosocial involvement in the family* raised the odds by 5% for non-drinking 9th graders who had one to two drinking peers to transition into becoming binge drinkers who had three to four drinking close friends one year later (peer influence transition) in relation to those who stayed in the same latent status. Nonetheless, the odds for this same latent subgroup of non-drinking 9th graders to transition into the "experimenters with 4 drinking friends" and the "drinkers with 2 drinking friends" latent statuses (*OR* = 0.98 for both peer influence transitions) were about the same for individuals at all levels of the predictor. For the moderating effect on transitions congruent with peer selection processes, decreased odds of transitioning from being experimenters who had non-drinking close friends in Grade 9 into being in the "binge drinkers with 4 drinking friends" latent status one year later were associated with a one-unit increase in risk factor (*OR* = 0.91). However, the odds of transitioning for this same latent subgroup of experimenters into the "drinkers with 2 drinking friends" (*OR* = 1.02) and the "binge drinkers with 4 drinking friends" (*OR* = 1.03) latent statuses were about the same for individuals at all level of the predictor (both peer selection transitions).

5.4.2.2 Effect of *covariates on transitions over time in Washington State*

Table 5.10 depicts the effect of *Pubertal timing* and *Family history of antisocial behaviour* in terms of odds ratios for transitions in Washington State.

Table 5.10
Odds ratios of statistically significant predictors of transitions between latent peer statuses in Grades 9 and 10 in Washington State.

	Latent Status				
	Non-drinkers + non-drinking friends	Non-drinkers + 2 drinking friends	Experimenters + 4 drinking friends	Drinkers + 2 drinking friends	Binge drinkers + 4 drinking friends
Effect of Pubertal timing on probability of transitioning to...			*... Grade 10 latent status*		
Conditional on Grade 9 latent status					
Non-drinkers + non-drinking friends	ref[1]	1.13	1.25	0.78	0.90
Non-drinkers + 2 drinking friends	0.87	ref	1.00[a]	1.03[a]	1.04[a]
Experimenters + 4 drinking friends	0.96	0.89	ref	0.91	0.89
Drinkers + 2 drinking friends	0.91	1.02	0.97	ref	0.96
Binge drinkers + 4 drinking friends	0.85	0.90	1.05	1.02	ref

	Non-drinkers + non-drinking friends	Non-drinkers + 2 drinking friends	Experimenters + 4 drinking friends	Drinkers + 2 drinking friends	Binge drinkers + 4 drinking friends
Effect of Family history of antisocial behaviour on probability of transitioning to...			*... Grade 10 latent status*		
Conditional on Grade 9 latent status					
Non-drinkers + non-drinking friends	ref	0.96	1.04	1.03	0.92
Non-drinkers + 2 drinking friends	1.05	ref	1.10[a]	1.05[a]	1.15[a]
Experimenters + 4 drinking friends	1.03	0.99	ref	1.02	0.97
Drinkers + 2 drinking friends	0.97	1.03	1.03	ref	1.02
Binge drinkers + 4 drinking friends	0.81	1.01	0.96	1.00	ref

ℓ = -5422.01. *Note*. All covariates entered simultaneously as predictors of Grade 9 to Grade 10 transitions.
[1]Diagonal element of the transition matrix served as the reference category. [a]Peer influence transitions.

5.4.2.2.1 *Pubertal timing*

Regarding the moderating effect of the perceived timing of puberty on peer influence transitions, early maturers and their late/on-time maturing counterparts had about the same odds of transitioning into the "experimenters with 4 drinking friends" (*OR* = 1.00), the "drinkers with 2 drinking friends" (*OR* = 1.03), and the "binge drinkers with 4 drinking friends" (*OR* = 1.04) latent statuses in Grade 10, from being non-drinkers who had one or two drinking best friends in the previous year. Further, the effect of *Pubertal timing* seem to have larger effects on non-drinking 9th graders who did not associate with any drinking best friends. Early maturers in this latent subgroup of non-drinkers were 1.13 and 1.25 times more likely than late/on-time maturers to transition into the "non-drinkers with 2 drinking friends" and the "experimenters with 4 drinking friends" latent statuses in Grade 10, relative to those who stayed in the same latent status. Within this same latent subgroup of non-drinkers early maturers were less likely to transition into the "drinkers with 2 drinking friends" (*OR* = 0.78) or the "binge drinkers with 4 drinking friends" (*OR* = 0.90) latent statuses compared to late/on-time maturers one year later.

5.4.2.2.2 *Family history of antisocial behaviour*

The moderating effect of this predictor on transitions due to peer influence processes was evident in the latent subgroup of non-drinkers who had one or two drinking best friends in Grade 9. A one standard deviation increase in *Family history of antisocial behaviour* raised the odds of transitioning into becoming experimenters who had three or four drinking close friends in Grade 10 (*OR* = 1.10), or "binge drinkers with 4 drinking friends" (*OR* = 1.15).

5.5 Summary

In overview the findings reported in this chapter revealed that by Grade 9 levels of alcohol use and associations with alcohol-using peers were considerably higher in both states relative to the younger cohorts. Five-latent-status models were found to best represent the peer group characteristics for both Victorian and Washington samples, with one latent status difference between the states. Again the alcohol use rate was more prevalent among Victorian 9th and 10th graders than their same age counterparts in Washington State. Three transitions congruent with peer selection were observed in Victoria only (10% of the sample). Three transitions congruent with peer influence were observed in both states; observed for 9% in Victoria and 12% in Washington State. *Family history of antisocial behaviour*, *Poor family management*, and *Parental attitudes favourable towards drug use* were found to be predictors of latent status membership in Grade 9 in both states. In addition, the *Proportion of drinkers in the classroom* predicted membership in latent peer groups in Grade 9 in Victoria only. With respect to prospective transitions between latent statuses, *Pubertal timing* and *Family history of antisocial behaviour* statistically significantly predicted transitions over time in both states. In addition, *Family conflict* and *Opportunities for prosocial involvement in the family* predicted prospective transitions between latent peer subgroups in Victoria only. *Family history of antisocial behaviour* was the only covariate that predicted Grade 9 latent status membership cross-sectionally, as well as transitions over time between latent peer statuses in both states.

Chapter Six: Integrated results

The chapter that follows reviews results from each of the three previous chapters exploring findings for all three cohorts in both states. Results are integrated and organised by cohort and state for easier examination and comparison. The chapter commences by presenting the prevalences of all identified latent peer statuses in each cohort followed by the proportion of stabilities in all grade levels by state. Next, probabilities of staying in the same latent peer status and transitioning into other latent peer statuses over the one-year period are presented. Proportions of cohort samples were calculated based on these transition probabilities in each cohort to allow direct comparisons between the two states. Further, the chapter includes results of the effect of statistically significant factors predicting baseline (Grades 5, 7 and 9) latent peer status memberships which are shown in the order of the number of latent statuses memberships predicted in each cohort by state. Finally, six statistically significant factors predicting prospective transitions that were congruent with peer influence and selection processes are reviewed. Observations were informed by comparing and contrasting results across cohorts and states. Interpretation and discussion of these integrated observations are presented in Chapter 7.

6.1 Prevalences of latent peer subgroups

Prevalences of all identified latent peer statuses, probabilities of staying in the same latent peer status and transitions over time are shown in Table 6.1. A graphical display of the prevalences of the identified latent statuses in the two states by grade levels is shown in Figure 6.1. Overall, across all cohorts and states the observed range of group characteristics were captured by nine latent subgroups: Two of non-drinkers with or without drinking friends; three of experimenters with or without drinking friends; three of current drinkers with or without drinking friends and; one of binge drinkers with drinking friends. While

all nine were evident in at least one cohort in Victoria, in Washington State seven latent peer subgroups were adequate to describe the range of peer group characteristics; in particular, two latent subgroups of experimenters with drinking friends and current drinkers without drinking friends were not identified. The majority of adolescents were classified into latent subgroups fitting criteria as non-drinkers with or without drinking peers only in Grades 6 (61%) and 7 (54%) in Victoria, whereas the majority of Washington adolescents were non-alcohol users with or without drinking close friends from Grades 5 (83%) to 9 (56%). It should be noted that these classifications are based on the probabilistic assignment of latent subgroups and are different to self-reported rates of alcohol use.

Latent subgroups of experimenters who tried alcohol in the absence of drinking peers emerged in Grades 5 and 6 in both states, with the proportion of Victoria experimenters (38%) more than twice that of their counterparts in Washington State (17%). Using alcohol alone among adolescents seemed to be uncommon in Washington State in that no more latent subgroups of these experimenters or current drinkers was identified in older grade levels beyond Grade 6. Whereas latent peer subgroups of experimenters or current drinkers without drinking peers were identified in all grade levels in Victoria. This potentially important difference is discussed in later sections.

By Grade 8 in Victoria, the majority of adolescents were categorised into latent subgroups defined as current drinkers with or without drinking best friends (60% vs. 21% in Washington State) and 89% (45% in Washington State) that fitted criteria for at least having experimented with alcohol by Grade 9. By Grade 10, the majority of Victorian adolescents were categorised into binge drinkers with drinking peers subgroups (51%) which was more than double that of their Washington counterparts (23%).

Table 6.1
Summary of prevalences of latent peer statuses at all grade levels, proportion of stabilities, and transition probabilities over time by state.

	Victoria			Washington State		
	G5 (N = 875)	G7 (N = 958)	G9 (N = 961)	G5 (N = 889)	G7 (N = 947)	G9 (N = 975)
Latent peer status prevalences (%; prevalences 1 year later in brackets)						
Non-drinkers + non-drinking friends	47 (61)	41 (25)	*	76 (77)	61 (45)	30 (21)
Non-drinkers + 2 drinking friends	*	13 (16)	12 (8)	7 (15)	20 (24)	26 (25)
Experimenters + non-drinking friends	38 (*)	*	20 (11)	17 (8)	*	*
Experimenters + 2 drinking friends	15 (*)	*	*	*	*	*
Experimenters + 4 drinking friends	*	*	20 (17)	*	7 (9)	19 (21)
Drinkers + non-drinking friends	* (17)	15 (11)	*	*	*	*
Drinkers + 2 drinking friends	* (22)	14 (15)	16 (13)	*	7 (9)	10 (10)
Drinkers + 4 drinking friends	*	17 (34)	*	*	5 (13)	*
Binge drinkers + 4 drinking friends	*	*	33 (51)	*	*	16 (23)
Probabilities of remaining in same latent peer status 1 year later (proportion of cohort sample in %)						
Non-drinkers + non-drinking friends	0.78 (37%)	0.48 (20%)	*	0.85 (65%)	0.61 (37%)	0.48 (14%)
Non-drinkers + 2 drinking friends	*	0.30 (4%)	0.25 (3%)	0.38 (3%)	0.32 (6%)	0.38 (10%)
Experimenters + non-drinking friends	*	*	0.31 (6%)	0.24 (4%)	*	*
Experimenters + 4 drinking friends	*	*	0.39 (8%)	*	0.23 (2%)	0.36 (7%)
Drinkers + non-drinking friends	*	0.25 (4%)	*	*	*	*
Drinkers + 2 drinking friends	*	0.31 (4%)	0.28 (4%)	*	0.25 (2%)	0.28 (3%)
Drinkers + 4 drinking friends	*	0.75 (13%)	*	*	0.53 (3%)	*
Binge drinkers + 4 drinking friends	*	*	0.89 (29%)	*	*	0.69 (11%)

Table 6.1 (continued)

	Victoria			Washington State		
	G5 (N = 875)	G7 (N = 958)	G9 (N = 961)	G5 (N = 889)	G7 (N = 947)	G9 (N = 975)
Probabilities of transitioning in patterns congruent with peer influence and reverse peer influence processes over 1 year (proportion of cohort sample in %)						
Peer influence						
non-drinkers + 2 drinking friends --> experimenters + 4 drinking friends	‡	‡	0.35 (7%)	‡	0.13 (3%)	0.31 (8%)
non-drinkers + 2 drinking friends --> drinkers + 2 drinking friends	‡	0.13 (2%)	0.10 (1%)	‡	0.08 (2%)	0.08 (2%)
non-drinkers + 2 drinking friends --> drinkers + 4 drinking friends	‡	0.30 (4%)	*	‡	0.13 (3%)	‡
non-drinkers + 2 drinking friends --> binge drinkers + 4 drinking friends	‡	‡	0.08 (1%)	‡	‡	0.08 (2%)
Reverse peer influence						
experimenters + non-drinking friends --> non-drinkers + non-drinking friends	0.50 (19%)	‡	‡	0.52 (9%)	‡	‡
drinkers + non-drinking friends --> non-drinkers + non-drinking friends	‡	0.10 (2%)	‡	‡	‡	‡

Table 6.1 (continued)

	Victoria			Washington State		
	G5 (N = 875)	G7 (N = 958)	G9 (N = 961)	G5 (N = 889)	G7 (N = 947)	G9 (N = 975)
Probabilities of transitioning in patterns congruent with peer selection processes over 1 year (proportion of cohort sample in %)						
Peer selection						
experimenters + non-drinking friends --> experimenters + 4 drinking friends	‡	‡	0.14 (3%)	‡	‡	‡
experimenters + non-drinking friends --> drinkers + 2 drinking friends	0.23 (9%)	‡	0.19 (4%)	‡	‡	‡
experimenters + non-drinking friends --> binge drinkers + 4 drinking friends	‡	‡	0.17 (3%)	‡	‡	‡
drinkers + non-drinking friends --> drinkers + 2 drinking friends	‡	0.23 (3%)	‡	‡	‡	‡
drinkers + non-drinking friends --> drinkers + 4 drinking friends	‡	0.39 (6%)	‡	‡	‡	‡

Table 6.1 (continued)

	Victoria			Washington State		
	G5 (N = 875)	G7 (N = 958)	G9 (N = 961)	G5 (N = 889)	G7 (N = 947)	G9 (N = 975)
Probabilities of transitioning in patterns congruent with a mix of peer processes (proportion of cohort sample in %)						
experimenters + 2 drinking friends --> drinkers + 2 drinking friends	0.45 (7%)	‡	‡	‡	‡	‡
experimenters + 4 drinking friends --> drinkers + 4 drinking friends	‡	‡	‡	‡	0.23 (2%)	‡
experimenters + 4 drinking friends --> binge drinkers + 4 drinking friends	‡	‡	0.42 (8%)	‡	‡	0.25 (5%)
drinkers + 2 drinking friends --> drinkers + 4 drinking friends	‡	0.46 (6%)	‡	‡	0.44 (3%)	‡
drinkers + 2 drinking friends --> binge drinkers + 4 drinking friends	‡	‡	0.59 (9%)	‡	‡	0.42 (4%)

*Latent status not identified in the respective cohort.

‡Transition not observed in the respective cohort.

G5 = Grade 5; G7 = Grade 7; G9 = Grade 9.

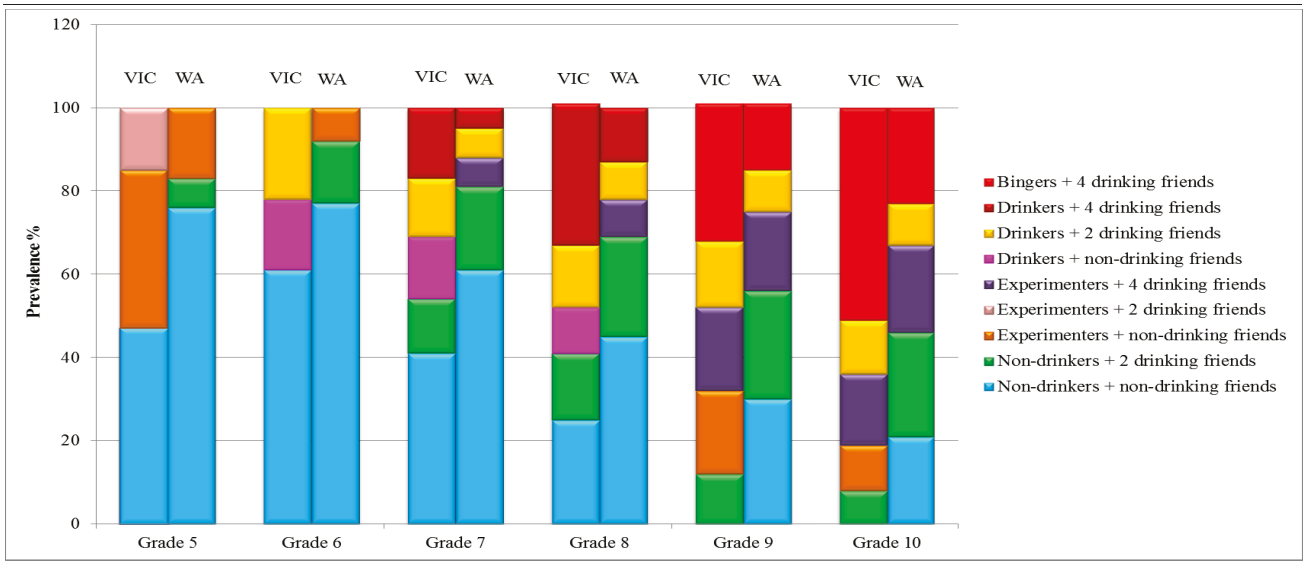

Figure 6.1. Prevalences of the nine identified latent stauses in Victoria and Washington State by grade levels.

6.2 Stabilities of latent peer status over time

The second section of rows in Table 6.1 displays the stabilities in terms of the proportion staying in the same latent peer subgroup during the one-year period for each cohort. Figure 6.2 shows the proportion of cohort sample remaining in the same latent peer subgroup in the two states by cohort. In the youngest cohort, the latent subgroup of non-drinking 5th graders without drinking peers had the highest probability of staying in the same latent subgroup over time (probability = 0.78 and 0.85 respectively for Victoria and Washington State). By multiplying the proportion remaining stable by the proportion of 5th graders that were assigned into the non-drinkers with non-drinking friends latent subgroup, it is possible to derive estimates of the total proportion of the Grade 5 and 6 cohort classified into this stable pattern. These stable non-drinkers who did not have any drinking best friends accounted for 37% (= 0.78 x 0.47) and 65% (= 0.85 x 0.76) of the Grade 5 and 6 cohort samples in Victoria and Washington State respectively.

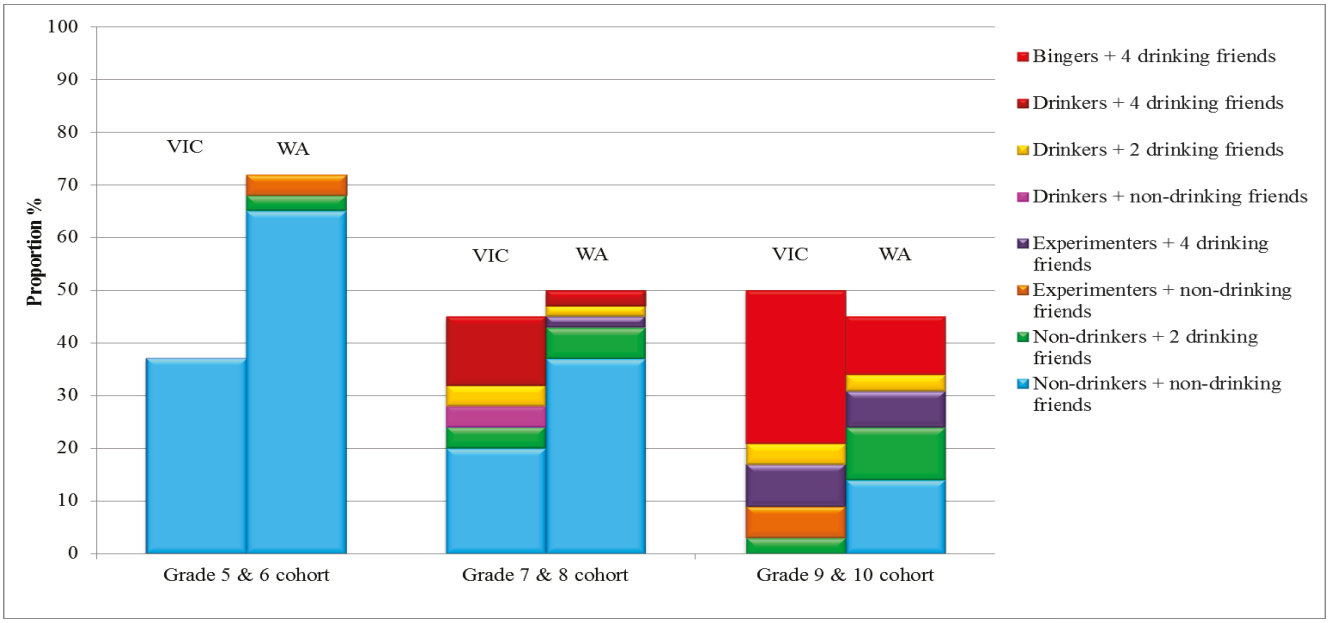

Figure 6.2. Proportion of cohort sample remaining in the same latent peer subgroup over the 1-year follow-up period in Victoria and Washington State by cohort.

For the Grade 7 and 8 cohort, the "non-drinkers with non-drinking friends" latent status continued to be the most stable latent status in Washington State (probability = 0.61; 37% of the cohort sample) and the second most stable latent status was the "drinkers with 4 drinking friends" latent status (probability = 0.53; 3% of the cohort sample). However, it was the "drinkers with 4 drinking friends" latent subgroup which displayed the highest stability (probability = 0.75; 13% of the cohort sample) while the "non-drinkers with non-drinking friends" latent status became the second most stable latent subgroup (probability = 0.48; 20% of the cohort sample) in Victoria. By Grade 10, the "binge drinkers with 4 drinking friends" latent subgroup showed the highest stability in both states (probability = 0.89 and 0.69 for Victoria and Washington State respectively); these stable binge drinkers accounted for 29% and 11% of the Grade 9 and 10 cohort sample respectively in Victoria and Washington State. The second most stable latent statuses were the "experimenters with 4 drinking friends" (probability = 0.39; 8% of the cohort sample) and the "non-drinkers with non-drinking friends" (probability = 0.48; 14% of the cohort sample) latent statuses for Victoria and Washington State respectively.

6.3 Transitions congruent with peer processes

The next section of rows in Table 6.1 presents the proportion in transitions that appeared congruent with peer influence, peer selection, and reverse peer influence processes. A graphical display of the proportion of cohort sample in transitions congruent with different types of peer processes is shown in Figure 6.3. Transitions congruent with peer influence were not evident in the youngest cohorts but were observed in the middle and most common in the oldest cohorts in Victoria and Washington State. Transitions congruent with peer influence were more common in Washington State in that three such transitions were found in each of the Grade 7 and 8, and Grade 9 and 10 cohorts. In total in Washington State, 8% and 12% of the cohort samples were categorised into peer influence congruent transitions in Grade 7 and 8 and Grade 9 and 10 respectively. In

Victoria, two and three transitions congruent with peer influence were observed in the middle (accounting for 6% of the cohort sample) and oldest (accounting for 9% of the cohort sample) cohorts respectively.

Transitions that were congruent with peer selection were not found in Washington State, but were observed in all cohorts in Victoria. The proportion in Victoria exposed to transitions congruent with peer selection were 9% in each of the Grade 5 and 6, and the Grade 7 and 8 cohorts, and 10% in the Grade 9 and 10 cohort. With respect to transitions congruent with reverse peer influence, the probabilities for experimenters who did not have any drinking peers in Grade 5 to revert to being non-drinkers one year later were comparable between the two states (0.50 for Victoria vs. 0.52 for Washington State). However, the percentage of the youngest cohort who were observed in these transitions were higher in Victoria (19%) than in Washington State (9%). A small percentage of transition in the Victorian Grade 7 and 8 cohort were congruent with these patterns (2%).

The bottom row of Table 6.1 show the transitions that were potentially congruent with a mix of peer influence and selection processes which resulted in either escalation of drinking status and/or acquisition of more drinking close friends. Among the Victorian 5th graders who had started experimenting with alcohol and had drinking close friends, the probability for them to escalate to being current drinkers with the same number of drinking peers was 0.45. This transition was congruent with a mix of peer processes and the proportion of the Grade 5 and 6 cohort sample who were subjected to this escalation was 7%. Escalation from being experimenters who had three or four drinking peers to binge drinkers was observed in the Grade 9 and 10 cohort in both states. Not only did Victorian experimenters have a higher probability of transitioning to binge drinkers subgroups (0.42 in Victoria vs. 0.25 in Washington State), the proportion of adolescents who were exposed to such transition was also higher (8% in Victoria vs. 5% in Washington State).

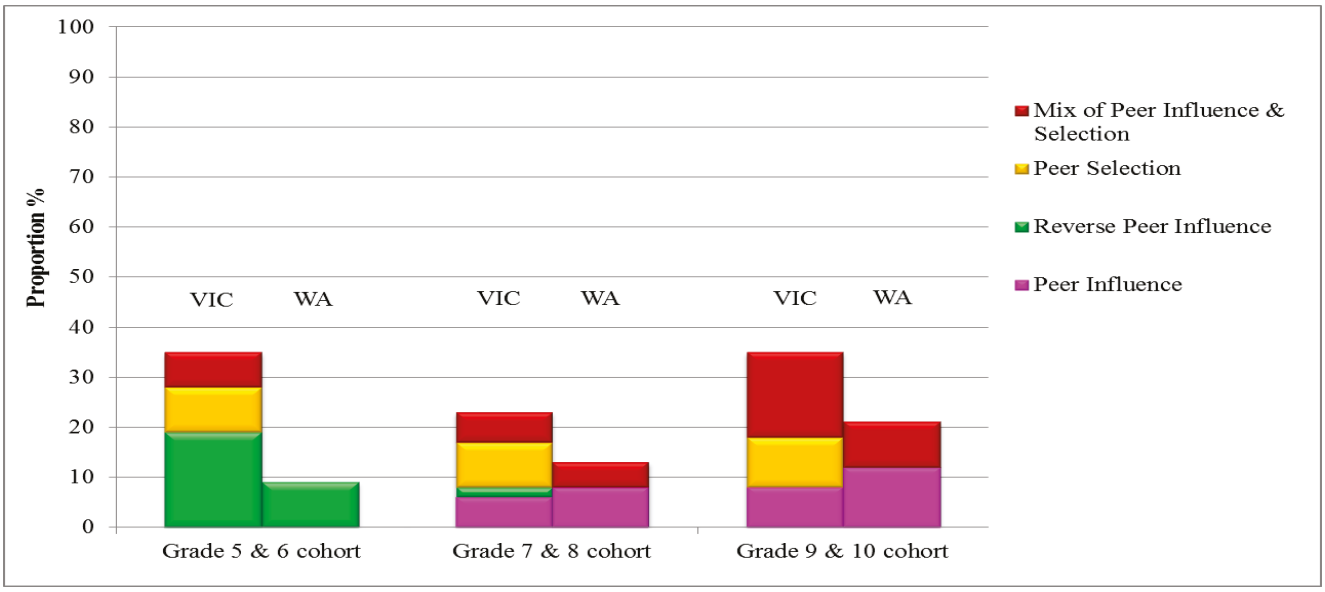

Figure 6.3. Proportion of cohort sample in transitions congruent with peer influence, reverse peer influence, peer selection, and mix of peer influence and selection processes in Victoria and Washington State by cohort.

When adolescents became current drinkers and associated with one or two drinking best friends, they had high probabilities of transitions that increased their drinking peer network. In Grade 7, for those who were already current drinkers and had one or two drinking close friends, the probability of acquiring more drinking peers were comparable in both states (0.46 in Victoria vs. 0.44 in Washington State). Nonetheless, the proportion of the cohort that underwent these transitions was 6% in Victoria, which doubled that in Washington State (3%). Additionally, drinking 9th graders who had drinking best friends in Victoria had a higher probability of becoming binge drinkers who had more drinking peers one year later than their Washington counterparts (0.59 in Victoria vs. 0.42 in Washington State). The proportion of the Victorian cohort subjected to such transitions was 9%, which was more than double that in Washington State (4%).

6.4 Factors predicting Time 1 latent status memberships and prospective transitions

Table 6.2 lists the latent peer status memberships predicted by each statistically significant covariate by cohort and state. Among the seven predictors identified, *Pubertal timing* predicted the least number of latent status memberships in that it predicted memberships in two latent statuses in Grade 5 in Washington State only. *Gender* predicted two latent status memberships in Grade 5 in both states. *Family conflict* was also identified as a statistically significant predictor in Grade 5 in both states and also predicted four latent status memberships in Grade 7 in Washington State. Moreover, *Proportion of drinkers in the classroom* was predictive of latent status membership in Grade 7 and 9 respectively in Washington State and Victoria. *Poor family management* was a predictor for all cohorts in Victoria and for Grade 7 and 9 in Washington State. In addition, *Family history of antisocial behaviour* and *Parental attitudes favourable towards drug use* significantly predicted eight latent status memberships across all three cohorts in both states.

Table 6.2
Effect of covariates predicting Time 1 latent status membership in odds ratios for all three cohorts by state.

	Victoria			Washington State		
	G5 (N = 875)	G7 (N = 958)	G9 (N = 961)	G5 (N = 889)	G7 (N = 947)	G9 (N = 975)
Pubertal timing (late/on-time maturer=0; early maturer=1)						
Non-drinkers + 2 drinking friends	*	ns	‡	2.32	ns	ns
Experimenters + non-drinking friends	ns	*	ns	2.31	*	*
Gender (female=0; male=1)						
Non-drinkers + 2 drinking friends	*	ns	‡	1.35	ns	ns
Experimenters + non-drinking friends	2.00	*	ns	2.17	*	*
Experimenters + 2 drinking friends	3.33	*	*	*	*	*
Family conflict						
Non-drinkers + 2 drinking friends	*	ns	‡	1.26	1.26	ns
Experimenters + non-drinking friends	1.24	*	ns	1.52	*	*
Experimenters + 2 drinking friends	1.53	*	*	*	*	*
Experimenters + 4 drinking friends	*	*	ns	*	1.66	ns
Drinkers + 2 drinking friends	*	ns	ns	*	1.38	ns
Drinkers + 4 drinking friends	*	ns	*	*	1.64	*
Proportion of drinkers in the classroom (%)						
Non-drinkers + 2 drinking friends	†	ns	*	†	1.25	ns
Experimenters + non-drinking friends	†	*	0.72	†	*	*
Experimenters + 4 drinking friends	†	*	1.08	†	1.40	ns
Drinkers + 2 drinking friends	†	ns	0.97	†	1.20	ns
Drinkers + 4 drinking friends	†	*	*	†	1.87	*
Binge drinkers + 4 drinking friends	†	*	1.35	†	*	ns

Table 6.2 (continued)

	Victoria			Washington State		
	G5 (N = 875)	G7 (N = 958)	G9 (N = 961)	G5 (N = 889)	G7 (N = 947)	G9 (N = 975)
Poor family management						
Non-drinkers + 2 drinking friends	*	1.22	‡	*	1.38	1.13
Experimenters + non-drinking friends	1.07	*	0.90	*	*	*
Experimenters + 2 drinking friends	1.57	*	*	*	*	*
Experimenters + 4 drinking friends	*	*	1.19	*	1.51	1.72
Drinkers + non-drinking friends	*	1.16	*	*	*	*
Drinkers + 2 drinking friends	*	1.26	1.37	*	2.12	1.91
Drinkers + 4 drinking friends	*	1.47	*	*	2.87	*
Binge drinkers + 4 drinking friends	*	*	1.70	*	*	2.25
Family history of antisocial behaviour						
Non-drinkers + 2 drinking friends	*	1.21	‡	2.10	1.38	1.76
Experimenters + non-drinking friends	2.35	*	0.77	1.65	*	*
Experimenters + 2 drinking friends	2.58	*	*	*	*	*
Experimenters + 4 drinking friends	*	*	1.66	*	2.47	3.12
Drinkers + non-drinking friends	*	1.21	*	*	*	*
Drinkers + 2 drinking friends	*	1.42	1.91	*	3.95	3.01
Drinkers + 4 drinking friends	*	1.66	*	*	4.34	*
Binge drinkers + 4 drinking friends	*	*	3.80	*	*	4.51

Table 6.2 (continued)

	Victoria			Washington State		
	G5 (N = 875)	G7 (N = 958)	G9 (N = 961)	G5 (N = 889)	G7 (N = 947)	G9 (N = 975)
Parental attitudes favourable towards drug use						
Non-drinkers + 2 drinking friends	*	1.01	‡	2.41	1.08	0.89
Experimenters + non-drinking friends	3.10	*	1.79	3.07	*	*
Experimenters + 2 drinking friends	2.73	*	*	*	*	*
Experimenters + 4 drinking friends	*	*	2.04	*	1.41	1.24
Drinkers + non-drinking friends	*	1.23	*	*	*	*
Drinkers + 2 drinking friends	*	1.29	3.10	*	1.97	1.86
Drinkers + 4 drinking friends	*	1.23	*	*	1.30	*
Binge drinkers + 4 drinking friends	*	*	3.90	*	*	2.04

*Time 1 latent status not identified in the respective wave.

‡The latent status served as the reference category in the multinomial logistic regression aanylses in the respective wave hence odds ratio was not estimated.

ns = the effect of covariate did not reach statistical significance in predicting the respective latent status.

†Covariate not tested in the respective wave.

G5 = Grade 5; G7 = Grade 7; G9 = Grade 9.

Note. Reference category was the "non-drinkers + non-drinking friends" latent status for Grade 5 and 7 in Victoria and Grade 9 in Washington State, except for Grade 9 in Victoria the reference category was the "non-drinkers + 2 drinking friends" latent status.

Significant moderators of prospective transitions that were congruent with peer selection, peer influence, and reverse peer influence processes are listed by cohort and state in Table 6.3. Only transitions with larger effect of covariates ($0.95 > OR > 1.05$) are shown in the table. In overview the covariates demonstrated differential effects on moderating transitions congruent with peer influence, peer selection or reverse peer influence. While peer selection transitions were only observed in Victoria, *Family conflict*, *Proportion of drinkers in the classroom*, and *Opportunities for prosocial involvement in the family* moderated one peer selection transition with relatively larger effect each in the Grade 5 and 6, Grade 7 and 8, and Grade 9 and 10 cohorts respectively. *Pubertal timing* moderated two peer selection transitions each in the Grade 7 and 8 and the Grade 9 and 10 cohorts, while the effect of *Family history of antisocial behaviour* moderated peer selection transitions in all three cohorts. Further, *Pubertal timing* moderated all three peer influence transitions in Washington State while only one in Victoria in the Grade 7 and 8 cohort. *Family history of antisocial behaviour* was predictive of two peer influence transitions in the Grade 9 and 10 cohort in Washington State while only one in Victoria in the Grade 7 and 8 cohort. Moreover, *Opportunities for prosocial involvement at school* moderated two transitions congruent with peer influence in the Grade 7 and 8 cohort in Washington State only. This effect was the reverse of expectations with greater prosocial opportunities associated with higher risk of the peer influence transition. There was only one transition congruent with reverse peer influence with a larger effect being exerted by *Pubertal timing* in Grade 5 and 6 in Victoria.

Across cohorts, *Family history of antisocial behaviour* was the only predictor for Time 1 latent status membership in Grades 5, 7, and 9 as well as transitions over time between latent peer subgroups in both states in all cohorts. *Pubertal timing* was found to predict prospective transitions between latent peer subgroups in both states in all cohorts.

Table 6.3
Summary of covariates predicting prospective transitions congruent with peer selection, peer influence, and reverse peer influence in odds ratios in all three cohorts by state.

	Victoria			Washington State		
	G5 (N = 875)	G7 (N = 958)	G9 (N = 961)	G5 (N = 889)	G7 (N = 947)	G9 (N = 975)
Peer selection transitions						
Pubertal timing (late/on-time maturer=0; early maturer=1)						
experimenters + non-drinking friends --> drinkers + 2 drinking friends	‡	*	1.22	*	*	*
experimenters + non-drinking friends --> binge drinkers + 4 drinking friends	*	*	0.93	*	*	*
drinkers + non-drinking friends --> drinkers + 2 drinking friends	*	1.16	*	*	*	*
drinkers + non-drinking friends --> drinkers + 4 drinking friends	*	1.20	*	*	*	*
Proportion of drinkers in the classroom (%)						
drinkers + non-drinking friends --> drinkers + 2 drinking friends	*	1.07	†	*	*	*
Opportunities for prosocial involvement in the family						
experimenters + non-drinking friends --> binge drinkers + 4 drinking friends	*	*	0.91	*	*	*

Table 6.3 (continued)

	Victoria			Washington State		
	G5 (N = 875)	G7 (N = 958)	G9 (N = 961)	G5 (N = 889)	G7 (N = 947)	G9 (N = 975)
Peer selection transitions (continued)						
Family history of antisocial behaviour						
experimenters + non-drinking friends --> experimenters + 4 drinking friends	*	*	1.08	*	*	*
experimenters + non-drinking friends --> drinkers + 2 drinking friends	1.16	*	‡	*	*	*
experimenters + non-drinking friends --> binge drinkers + 4 drinking friends	*	*	1.08	*	*	*
drinkers + non-drinking friends --> drinkers + 2 drinking friends	*	1.08	*	*	*	*
drinkers + non-drinking friends --> drinkers + 4 drinking friends	*	1.07	*	*	*	*
Family conflict						
experimenters + non-drinking friends --> drinkers + 2 drinking friends	1.09	*	‡	*	*	*

Table 6.3 (continued)

	Victoria			Washington State		
	G5 (N = 875)	G7 (N = 958)	G9 (N = 961)	G5 (N = 889)	G7 (N = 947)	G9 (N = 975)
Peer influence transitions						
Pubertal timing (late/on-time maturer=0; early maturer=1)						
non-drinkers + 2 drinking friends --> experimenters + 4 drinking friends	*	*	‡	*	1.17	‡
non-drinkers + 2 drinking friends --> drinkers + 2 drinking friends	*	1.13	‡	*	1.10	‡
non-drinkers + 2 drinking friends --> drinkers + 4 drinking friends	*	‡	*	*	1.11	*
Family history of antisocial behaviour						
non-drinkers + 2 drinking friends --> experimenters + 4 drinking friends	*	*	‡	*	‡	1.10
non-drinkers + 2 drinking friends --> drinkers + 4 drinking friends	*	1.07	*	*	‡	*
non-drinkers + 2 drinking friends --> binge drinkers + 4 drinking friends	*	*	‡	*	*	1.15

Table 6.3 (continued)

	Victoria			Washington State		
	G5 (N = 875)	G7 (N = 958)	G9 (N = 961)	G5 (N = 889)	G7 (N = 947)	G9 (N = 975)
Peer influence transitions (continued)						
Opportunities for prosocial involvement at school						
non-drinkers + 2 drinking friends --> experimenters + 4 drinking friends	*	*	ns	*	1.08	ns
non-drinkers + 2 drinking friends --> drinkers + 2 drinking friends	*	ns	ns	*	1.13	ns
Reverse peer influence transitions						
Pubertal timing (late/on-time maturer=0; early maturer=1)						
experimenters + non-drinking friends --> non-drinkers + non-drinking friends	0.62	*	*	‡	*	*

*Transition not observed in the respective cohort. ‡Odds ratios between 0.95 and 1.05.
ns = the effect of covariate did not reach statistical significance in predicting the respective transition.
†Covariate not tested in the respective wave. G5 = Grade 5; G7 = Grade 7; G9 = Grade 9.
Note. Reference category was those who remained in the same latent peer status 1 year later. Except for the transitions made by individuals in the "experimenters + non-drinking friends" latent status in Grade 5, the reference category was experimenters who escalated to being current drinkers without drinking peers in Grade 6. For the transitions made by individuals in the "experimenters + 2 drinking friends" latent status in Grade 5, the reference category was experimenters who escalated to being current drinkers with 2 drinking peers.

Chapter Seven: Integrated discussion and conclusions

This chapter provides discussion and interpretation of results from all three cohorts and in each state. The chapter begins with a discussion of evidence generated from the LTA models in relationship to the hypotheses postulated by the PPM, in terms of the relative contribution and directionality of the peer influence and selection mechanisms in different stages of adolescent development. This is followed by a discussion of the identified predictors of latent transitions and how these predictors support the constructs proposed by the PPM. The chapter then discusses the implications of the findings for charting future directions for preventing alcohol consumption in different periods of adolescence and the value of using the PPM for theoretical guidance. The chapter ends with a discussion of the strength and limitations of the PPM and the empirical study.

7.1 The findings in relationship to the Peer Process Model

7.1.1 Evidence from the youngest cohort

According to the transition probabilities in the LTA model in Victoria (see summary Table 6.1), the link between "early alcohol use/initiation" and "early peer selection" proposed by the PPM (see Figure 1.1) was supported by results in this study. A major finding was that transitions congruent with peer selection were only observed in Victoria, where rates of early age alcohol use were higher than Washington State. Transitions congruent with peer selection accounted for 9% of the 5th graders in Victoria, with those who had tried alcohol in the absence of any drinking close friends having a 0.23 probability of acquiring one or two drinking close friends one year later. The finding that peer selection was only evident in Victoria may be explained by the higher level of early age exposure to

family risk factors in Victoria. Prior IYDS studies have demonstrated that parental supply of alcohol to early adolescents (McMorris et al., 2011) and favourable parental attitudes to substance use (Hemphill et al., 2011) are higher in Victoria compared to Washington State. Such an explanation is in line with the predictions of the PPM that risk factors that contribute to early alcohol use/initiation increase the likelihood of early peer selection.

Consistent with the PPM, several early risk factors predicted a higher odds of being classified into a latent subgroup initiating alcohol in Grade 5 in the absence of peers, a necessary precondition for peer selection. Elevated levels in *Family history of antisocial behaviour*, *Family conflict*, and *Parental attitudes favourable towards drug use* associated with increased odds of being experimenters without any drinking peers compared to non-users who did not have any drinking close friends in Grade 5 in both states and *Poor family management* was also predictive in Grade 5 in Victoria (Table 6.2). These early family risk factors were conceptualised to be part of the snowball risk processes. As they predicted early alcohol initiation in the absence of drinking peers the PPM hypothesis was supported that snowball risk processes influence a small group of early alcohol initiators to use alcohol in the absence of drinking peers.

The PPM prediction that peer selection emerges after the pubertal transition was only partly supported. Early maturing individuals (those one standard deviation above the mean on the PDS relative to their same-age peers) were 2.31 times more likely than late/on-time maturers to be experimenters who did not have any drinking best friends in Washington State. This association partly supported the premise that early peer selection emerges after the pubertal transition, as early maturing individuals had a higher odds of initiating alcohol at a young age in the absence of drinking peers. However, this effect was not found in Victoria where early age alcohol use was more normative.

The finding of transitions compatible with reverse peer influence in the youngest and other cohorts was not predicted by the PPM. This phenomenon is discussed in later sections.

7.1.2 Evidence from the middle cohort

Evidence of the reinforcing characteristics of alcohol use and peer groups was observed in the middle cohort in both states, where the highest stabilities were evident in the latent subgroups involving binge alcohol users with three or four drinking friends and non-drinkers with non-drinking friends. The former transitions characterised a greater percentage in Victoria (13% vs. 3% in Washington State), while the latter transitions applied to a greater percentage in Washington State (37% vs. 20% in Victoria; see summary Table 6.1).

The PPM postulated that individuals impacted by snowball risk processes (e.g. *Family history of antisocial behaviour*, *Parental attitudes favourable towards drug use*) would be more motivated to start drinking on their own. The PPM argued that this group would then be more likely to engage in peer selection, seeking out friends who also use alcohol. The PPM postulated that this behaviour would also be more likely amongst early maturers. As outlined in the sections above, these propositions applying to early adolescence were evident in the youngest cohort in Victoria. The PPM posited that these early adolescent behaviours would in turn contribute to the conditions that set-off snowstorm risk processes, whereby the increasing aggregation of drinking peers would increase peer influence transitions, with one mechanism of exposure occurring through an increase in the aggregation of drinking peers in classrooms and schools.

The findings for the middle cohort were mainly in alignment with these PPM propositions. In the middle cohort, transitions congruent with peer selection processes continued to be evident only in Victoria (where family norms were more favourable to adolescent alcohol use) whereas transitions congruent with

peer influence emerged in both states (characterising 8% in Washington State and 6% in Victoria). The finding that peer influence emerged in the middle cohort but was not evident in the younger cohort was in line with the PPM postulate that peer influence would be more prominent among older adolescents.

There was some support for the proposition that the level of exposure to alcohol-using peers in the classroom or school would be a mechanism for snowstorm risk. Table 6.2 also revealed that the *Proportion of drinkers in the classroom* was associated with an increased likelihood of being in riskier peer subgroups (e.g. non-drinker or drinker subgroups exposed to more drinking peers) in Washington State. Table 6.3 revealed that a one-unit increase in the *Proportion of drinkers in the classroom* increased the odds for only one latent transition congruent with peer selection in Victoria whereby current drinkers with non-drinking friends were 7% more likely to transition into peer groups with more drinking peers one year later. These effects of increased exposure to drinking peer aggregation provide some support for one mechanism explaining the PPM path from "snowstorm risk processes" to "late peer influence".

Consistent with the PPM, several of the family factors, selected to identify potential early risk factors, were associated with classification into latent subgroups that involved alcohol use with alcohol-using friends in Grade 7. *Family history of antisocial behaviour*, *Parental attitudes favourable towards drug use* and *Poor family management* were all associated with Grade 7 latent subgroups of drinkers with drinking friends in both states, while *Family conflict* was predictive in Washington State (see summary Table 6.2).

7.1.3 Evidence from the oldest cohort

The PPM postulation that peer influence would be more apparent in older adolescents was again in evidence in the older cohort. Three transitions that were congruent with peer influence were observed among subgroups of non-drinking

9th graders who had one or two drinking best friends in both states. These transitions congruent with peer influence were slightly more prominent in Washington State (12%) than in Victoria (9%). As alcohol use had been initiated by the majority in Victoria and for a large group in Washington State, many more of the older cohorts were classified into latent status subgroups that involved alcohol use. In Washington State transitions in some cases involved not using alcohol but moving into friendships with alcohol users. Ninth graders who had increased levels in *Poor family management* and *Family history of antisocial behaviour* were more likely to be non-drinkers who had one or two drinking friends in Washington State (rather than non-drinkers with no drinking friends).

Elevated levels of *Poor Family Management*, *Family history of antisocial behaviour* and *Parental attitudes favourable towards drug use* predicted Grade 9 latent status membership that involved binge alcohol use. Transitions were observed from Grade 9 into binge drinking in Grade 10 that were congruent with mixed peer processes and accounted for 17% in Victoria and 9% in Washington State. These findings provide partial support for the link posited in the PPM between "late peer influence" and "high prevalence alcohol-related problems".

Transitions congruent with peer selection were observed among a subgroup of 9th graders who experimented with alcohol in the absence of drinking peers in Victoria (10% of cohort sample). The finding that transitions congruent with peer selection occurred only in Victoria where rates of early age alcohol use were higher, supported the PPM proposition that early alcohol initiation contributes to "late peer selection".

Elevated levels in *Parental attitudes favourable towards drug use* was associated with an increased odds of being experimenters who did not have any drinking close friends in Grade 9 (a necessary pre-condition for peer selection), while increased levels in *Poor family management* and *Proportion of drinkers in the classroom* reduced the likelihood relative to the reference category of non-drinkers with one or two drinking friends (Table 6.2). *Early pubertal timing* and

Family history of antisocial behaviour predicted one or more transitions congruent with peer selection in Grade 10 (Table 6.3). In line with the PPM two snowstorm risk factors moderated transitions that were congruent with late peer selection. Early pubertal timing increased the risk of experimenters with non-drinking friends transitioning to drinkers with one or two drinking friends, but decreased the risk of transitioning to bingeing with three or four drinking friends. *Opportunities for prosocial involvement in the family* reduced the risk of this group transitioning to binging with three or four drinking friends (Table 6.3).

Some support for the PPM path between "snowstorm risk processes" and "late peer influence" was found among the subgroup of experimenters who were exposed to a high aggregation of drinking peers (had three or four drinking close friends). These experimenters had a 0.25 (Washington State) and 0.42 (Victoria) probability of transitioning into being binge drinkers who maintained the same number of drinking peers in Grade 10 (Table 6.1). Evidence for an increased risk of late peer influence due to aggregation of drinking peers was also evident in the analysis of snowball risk factor associations with latent groups at Time 1. Higher levels in the *Proportion of drinkers in the classroom* variable was associated with a higher likelihood of being experimenters or binge drinkers with three or four drinking close friends in Grade 9 in Victoria (Table 6.2). The finding that 29% of the cohort in Victoria and 11% in Washington State were stable binge drinkers from Grades 9 to 10 suggested the existence of a normative drinking culture that can be posited to be an important part of the snowstorm risk process. While subgroups of adolescents emerged as binge drinkers who had drinking best friends by Grade 9 in both states, half (51%) of the Victorian 10th graders were assigned into binge drinkers latent group. This common phenomena of latent groups associated with binge alcohol use are referenced in the PPM as "high prevalence alcohol-related problems", as they involve consuming alcohol frequently, in high volumes and with often serious consequences. Longitudinal analyses that examine the young adult consequences for these prevalent high-risk groups of mid-adolescents are essential.

7.2 Implications for alcohol use prevention and intervention through early adolescence

The findings presented in the empirical study reinforce the view that there are important opportunities to prevent adolescent alcohol use in adolescence, with this finding of special relevance in Australia (Lubman, Hides, Yücel, & Toumbourou, 2007). The implications for alcohol use prevention at different phases of adolescent development are discussed in the sections below.

Results from the LTA models provided a more nuanced and detailed picture of peer group inter-relationships with adolescents' self-reported drinking behaviours than has been available in prior studies. A comprehensive view of the range of alcohol-using behaviours among adolescents in both states was uncovered using this modelling technique. The techniques applied to the present study may have wider practical implications for targeting prevention science efforts. Using these techniques researchers may be able to identify groups of early adolescents that have a greater probability of either advancing to a higher level of alcohol consumption or of increasing exposure to drinking peers. Identification of factors that associated with an increased likelihood of either current involvement in or transitioning into riskier peer groups provides a potentially valuable means for theorising the application of prevention or intervention strategies.

7.2.1 Opportunities for preventive intervention among 11 and 12 year-olds

The empirical study identified a range of potential opportunities for preventive interventions within the youngest cohort that were in the early adolescent age group. Although alcohol use appeared far less stable than at later age periods, there were high rates of alcohol use evident, especially in the

Victorian sample. From Grades 5 to 6 only 37% of Victorian young adolescents were stable non-drinkers, compared to 65% of their Washington counterparts (Table 6.1). In broad overview the first conclusion that can be reached in studying the cross-national differences evident in the IYDS is that current efforts in Australia to implement harm minimisation have failed to protect young adolescents from the developmental harms associated with early age alcohol use, while in the US abstinence policies have been associated for over three decades with lower rates of early age alcohol and drug use (Toumbourou et al., 2009). Analysis of the longitudinal IYDS findings have revealed that, although rates of early age alcohol use are substantially higher in Victoria relative to Washington State, the longitudinal risk that early age alcohol use will lead to heavy and harmful adolescent alcohol use is of equal strength in both countries (Mason et al., 2011). These findings suggest the critical importance in Australia of implementing similar preventive interventions to those that have been successfully implemented in the US since the 1980s to reduce adolescent alcohol use (Toumbourou et al., 2009).

Findings from the current study provide more nuanced information on the pathways and peer processes associated with transitions to increases in early adolescent alcohol use. Thirty-five percent of 5th graders in Victoria transitioned in patterns congruent with peer processes whereas the proportion of Washington youth was only 9%. Of those 35% of Victorian youth, 7% were experimenters with drinking peers who had escalated their drinking status potentially driven by a mix of peer influence and selection processes. Another 9% of Victorian 5th graders were experimenters who had no drinking peers and whose transitions were congruent with self-selection into drinking peer groups as well as escalation to being current drinkers in Grade 6. The largest group who made transitions were experimenters who reverted to being non-drinkers in the presence of non-drinking peers, which accounted for 19% of the cohort sample. Similar transitions congruent with reverse peer-influence were also observed in 9% of the Washington sample. These observations would suggest that experimenters who have tried alcohol in the absence of drinking peers in Grade 5 may be an

appropriate target for interventions in Grade 5 in both countries, focussing on desistance. The fact that these experimenters had a 0.50 probability in Victoria (0.52 in Washington State) of reverting to non-drinkers in Grade 6 suggests a window of opportunity for intervention. Unfortunately, the present study was not able to identify factors that consistently moderated transitions that were congruent with reverse peer influence. In Victoria late maturers were found to be less likely to make these transitions (*OR* = 0.62).

The PPM model suggests that in order to intervene and prevent children from initiating alcohol use an important strategy is to lower the number or the level of early family (snowball) risk factors. Findings from the current study supported and demonstrated that snowball risk factors were associated with Time 1 latent status groups. Elevated levels in *Family conflict*, *Family history of antisocial behaviour*, and *Parental attitudes favourable towards drug use* were associated with increased odds of being experimenters in the absence of drinking peers (a necessary pre-condition for peer selection) in Grade 5 in both states (see Table 6.2). The analysis of factors moderating transitions revealed that *Family history of antisocial behaviour and Family conflict* were associated in Victoria with a greater likelihood of making transitions congruent with peer selection (experiments with no drinking peers in Grade 5 transitioning to current drinkers who have drinking peers) in Grade 6. Trialling interventions that target these family risk factors may be able to establish whether they play a causal role in influencing early adolescent alcohol-related peer processes. *Pubertal timing* was found to moderate transitions congruent with reverse peer-influence. Early pubertal developers were less likely to transition in Grade 5 from being experimenters with non-drinking friends to being non-drinkers (*OR* = 0.62). This effect may have been due to the higher likelihood for early maturers' to affiliate with older peer groups where alcohol use are age-normative for the group but not for them (Shelton & Van Den Bree, 2010).

The current findings that early family risk factors were associated with early adolescent latent status groups and decisions highlight the importance of

working with parents or caregivers in prevention and early intervention efforts. Intervention strategies for reducing family risk factors in early adolescence include parent training and family intervention programs (Spoth, Redmond, & Shin, 1998). The present findings suggest the focus of such programs may be on reducing risk factors such as family conflict and parents' favourable attitudes towards alcohol and drug use, and also on enhancing family management to reduce adolescent access to alcohol and ability to socialise with alcohol-using peers.

The current findings also suggest that, at least with Victorian 5th graders, preventive interventions could also focus on individual attitudes. Specifically findings suggested that 5th graders who were experimenters and had drinking close friends had positive beliefs that alcohol consumption would be considered "cool" by their peers. Prior longitudinal studies in the IYDS have shown that favourable attitudes to alcohol are important longitudinal predictors of adolescent alcohol use (Hemphill et al., 2011). Previous research has shown that child alcohol use schemas (expectancies assessed as young as at ages 3 to 5) predicted early drinking onset 9 years later, even when the effects of parental alcohol use were statistically removed (Donovan et al., 2004). In addition, children as young as 4th graders who have positive expectancies towards alcohol are more likely to be early initiators (e.g. Pasch, Perry, Stigler, & Komro, 2009). As these studies were initiated prior to the age of child alcohol use, they highlight the potentially important role that child alcohol expectancies and attitudes play in predicting early alcohol initiation. These previous findings are consistent with the findings of the present study in suggesting that to reduce children's favourable attitudes to alcohol, it may be necessary to intervene in primary school age groups, especially for high-risk children (Donovan, 2007; Pasch et al., 2009).

The fact that Washington youth showed a much lower probability of positive peer alcohol expectancies suggests that policy factors such as abstinence and zero-tolerance approaches towards alcohol use among minors may play an important role in forming alcohol expectancies among young children. Thus, in

addition to targeting parents and caregivers and providing prevention programs at primary school, it is likely that prevention efforts may also need to focus on policies at the community-, state-, and national- levels to complement efforts to delay the onset of adolescent alcohol use.

7.2.2 Opportunities for preventive intervention among 13 and 14 year-olds

In the middle cohort, the proportion of non-drinkers continued to shrink in both states over the one-year follow up. In overview there continued to be some opportunities to prevent alcohol initiation, however, these were of a diminishing scale in Victoria. Only 20% of Victorian 7th graders were stable non-drinkers, compared to 37% of their same-age peers in Washington State (see Table 6.1). The second most stable drinking status was stable current drinkers who had three or four drinking peers in Victoria which accounted for 13% of the cohort sample; whereas in Washington State, it was the peer group consisting of non-drinkers who had one or two drinking peers which accounted for 6% of the cohort sample.

Transitions congruent with peer influence were evident in both states (6% Victoria and 8% Washington State), whereby exposure to alcohol-using peers preceded transitions to an escalated drinking status. Further, peer selection processes were only observed in Victoria which affected 9% of the cohort sample. Another 6% of the Victorian sample and 5% of the Washington sample were subjected to a mix of peer processes in which they had acquired more drinking peers or escalated their drinking status. By Grade 8, the most prevalent peer subgroup was current drinkers who had three or four close drinking friends in Victoria (34% vs. 17% in Grade 7). Although the proportion of current drinkers was relatively low in the same grade level in Washington State, the proportion increased from 5% in Grade 7 to more than double, to 13% one year later. These findings suggest that the transition from Grades 7 to 8 is an important one in which alcohol use tends to escalate. The fact that this escalation occurred in both

states suggests that it may be influenced less by contextual factors and more by universal factors such as age and puberty. Hence, one focus of intervention in this cohort for both countries may be on early interventions with 7th graders who are current drinkers and already have drinking peers. This group of 7th graders were at risk of escalating in alcohol use. Unfortunately, there have been few interventions in Australia to date that have been successful in reducing alcohol use in this group (Loxley et al., 2004). The focus of current policies in Australia is on reducing the availability of alcohol to adolescents.

Factors that were associated in Grade 7 with current drinkers who had drinking peers in Grade 7 included *Poor family management*, *Family history of antisocial behaviour*, and *Parental attitudes favourable towards drug use* in both states. Additionally, *Family conflict* and *Proportion of drinkers in the classroom* were associated in Washington State.

As discussed earlier, past research has demonstrated that positive alcohol expectancy is associated with higher levels of drinking and prospective transitions to increased levels of drinking among adolescents (Bekman et al., 2011; Windle et al., 2008). By Grade 7, even the Victorian non-users had a high probability of positive beliefs that alcohol use would be considered cool by their peers, whereas in Washington State only adolescents who had started experimenting with alcohol evaluated the use of alcohol in this way. Among the two subgroups of Victorian non-drinkers, they had 0.52 (without drinking peers) and 0.68 probabilities (with one or two drinking peers) of evaluating alcohol use as cool (see Table 4.3). These findings reiterate the difficulty of targeting prevention strategies in Grade 7 in Victoria as much as changing positive beliefs toward alcohol and an entrenched culture of alcohol use were already in evidence.

Most seventh graders have just transitioned into a new high school environment which can be a stressful event for many and the norms towards alcohol use are very different compared to primary/elementary schools. This new environment provides opportunities to interact with older peers and being new

comers Grade 7 students may feel pressure to fit in with peers (Zucker et al., 2008).

The present findings revealed that Grade 7 was a time when non-drinkers made transitions that were congruent with peer influence, whereas these transitions were not evident in Grade 5. Early maturing 7th graders appeared to be more susceptible to transitions that were congruent with peer influence processes than their late/on-time counterparts. Early maturers who were non-drinkers and had one or two drinking peers were more likely to have escalated their drinking status and/or have acquired more drinking peers compare to late/on-time developers one year later (*OR*s ranged from 1.10 to 1.17; see Table 6.3). While transitions congruent with peer selection were not observed in Washington State, early maturers who had started drinking on their own also had higher odds of acquiring more drinking peers compared to late/on-time developers in Grade 8 in Victoria (see Table 6.3).

Opportunities for prosocial involvement at school was identified as a moderator of transitions congruent with peer influence in Washington State whereby for non-drinkers with one or two drinking close friends, increased levels in the moderator increased their odds of transitioning into being experimenters or current drinkers who had drinking peers in Grade 8. Thus *Opportunities for prosocial involvement at school* in Washington State increased the risk of adolescents' peer influenced alcohol use. Prosocial school opportunities such as involvement in sports clubs may not be protective where they increase access to alcohol and aggregation with alcohol-using youth (Mays & Thompson, 2009). Efforts need to be made to ensure school activities are structured to protect youth from alcohol-related risks (Crawford & Novak, 2002).

7.2.3 Opportunities for preventive intervention among 15 and 16 year-olds

In overview there were relatively few opportunities for primary prevention of alcohol use and alcohol-related peer processes by Grade 9, particularly in Victoria. By Grade 9, alcohol use was well acculturated in that the majority of Victorian non-drinking 15 year-olds had at least one best friend who used alcohol, while the largest peer groups still consisted of non-drinkers who did not have drinking peers in Washington State (30% in Grade 9). Transitions congruent with peer influence were evident in both states accounting for 9% in Victoria and 12% in Washington State (see Table 6.1). Ten percent of the Victorian sample were observed to make transitions congruent with peer selection processes. In addition, 17% (Victoria) and 9% (Washington State) of the cohort sample escalated their drinking status and acquired more drinking peers over time in patterns congruent with a mix of peer processes.

The most prevalent peer group comprised binge drinkers who had three or four drinking best friends in both Grades 9 (33%) and 10 (51%) in Victoria. These binge drinkers displayed a high probability (0.89) of staying as binge drinkers over the one-year period and 29% of the cohort sample were stable binge drinkers. Although only 11% of Washington sample were stable binge drinkers, these binge drinkers also showed high stability of remaining binge drinkers over time (probability = 0.69).

Adolescents in this age period typically start to spend more time socialising with their peers and spend more time outside of the home, e.g. being invited to parties. This subgroup of bingers had a high probability of accepting alcoholic drinks offered by friends at parties (0.93 in Victoria vs. 0.87 in Washington State). These binge drinkers, in both states, tended to associate with three or four drinking close friends, implying that by Grade 9 adolescent binge alcohol use was a social phenomenon. By Grade 9 it appeared that prevention was less the intervention of choice, but that wide-spread treatment approaches will

in fact be necessary in Victoria to address the health and social problems that are likely to follow such high levels of heavy alcohol use.

In the analysis of Grade 9 covariates a number of family risk factors were associated with binge alcohol use including the levels of *Family history of antisocial behaviour*, *Poor family management*, and *Parental attitudes favourable towards drug use* in both states. There were relatively few factors that moderated transitions that were congruent with peer influence from Grades 9 to 10. *Family history of antisocial behaviour* was associated with an increased risk of transitions congruent with peer influence in Washington State and with peer selection in Victoria. There was only one transition congruent with peer selection with larger effect exerted by *Opportunities for prosocial involvement in the family* observed in Victoria. *Pubertal timing* was identified with moderation of transitions congruent with peer selection in Victoria. While past research have found that the effects of pubertal timing decrease with age (Biehl et al., 2007), the current findings suggest at least some evidence that the timing of puberty may continue to be predictive in later adolescence.

7.2.4 Cross-cohort and cross-national observations

The present findings provide information on the developmental differences for students of similar school grade and age in the two states and hold unique relevance to efforts to understand how peer processes are similar or distinct in different cultural contexts at different periods in adolescent development. In summary rates of early adolescent alcohol use in Victoria, where harm-minimisation policies have been promoted, were substantially higher than in Washington State, where abstinence and zero-tolerance policies have been applied (Beyers, Evans-Whipp, Mathers, Toumbourou, & Catalano, 2005). In broad overview, these differences were associated with alcohol use transitions in Victoria being congruent with peer selection, while in Washington State no such transitions were evident. This finding suggest that national alcohol policies may

be one factor associated with the characteristics of peer processes that affect different stages of adolescence.

One mechanism by which national alcohol policies may influence adolescent peer processes is through parent and family practices. Previous cross-national analyses within the IYDS have demonstrated that family risk factors for adolescent alcohol use are higher in Victoria than in Washington State including: Favourable family attitudes to alcohol and drugs (Hemphill et al., 2011) and parent provision of alcohol (McMorris et al., 2011). These studies found that, although family risk factor levels were higher in Victoria, their longitudinal influence on adolescent alcohol use tended to be cross-nationally similar. Findings from the present study tend to confirm these findings.

In general covariates showed identical cross-national effects, in both cross-sectional and prospective associations. *Family history of antisocial behaviour* was the only factor identified that predicted peer subgroup memberships at Time 1 (Table 6.2) as well as transitions between at least some peer subgroups over time (Table 6.3) in all cohorts in both states. Perhaps associated with the more deviant nature of adolescent alcohol use in Washington State, cross-sectional effects were slightly larger in Washington State than Victoria. The differential effect of *Family history of antisocial behaviour* was demonstrated on different peer subgroups and cohorts which implies that the same intervention point will require different strategies for adolescents with different peer group characteristics. Targeting parents and caregivers in Australia that are characterised by high rates of alcohol use and/or drug use would benefit adolescents across these age cohorts. This is supported by previous findings that showed that parents can delay increase alcohol use among adolescents by keep strict house rules about drinking and alcohol-specific parenting seems to be influential before adolescents initiate alcohol use (e.g. van der Vorst et al., 2009). *Parental attitudes favourable towards drug use* had many cross-nationally similar associations with latent status groups at Time 1 in all cohorts and *Poor family management* showed many similarities in cross-national associations in Grades 7 and 9 (Table 6.1). In

overview these findings suggest that US prevention science programs that aim to reduce family risk factors (e.g. Kumpfer, Alvarado, Smith, & Bellamy, 2002; Spoth et al., 1998) should be evaluated for effects in Australia.

Pubertal timing predicted a number of transitions congruent with peer influence in Grade 7 in both states and also influenced selection transitions. This finding highlights the possibility that puberty has culturally similar effects on peer processes and suggests the potential to develop and evaluate selective interventions that target alcohol prevention interventions to early maturers around Grade 7. *Gender* significantly predicted peer group memberships in both states in Grade 5, but not in the other cohorts. These findings suggest the possibility that boys and girls may require slightly different prevention strategies in early adolescence (Saraceno, Heron, Munafò, Craddock, & van den Bree, 2012). No gender differences were found in latent subgroups or transitions among older adolescents suggesting that peer processes related to alcohol use may be generally similar across each gender as adolescence progresses.

7.3 Strengths and limitations

One of the important limitations of the empirical study is that the IYDS is an observational study that included a cross-sectional and prospective design. An important limitation of observational studies is that they can only weakly infer causality. Studies that attempt to experimentally manipulate interventions to peer groups or aim to modify risk factors are valuable in helping to extend a causal understanding of peer processes.

Another potential limitation of the present study was that longitudinal observations were limited to a one year of follow-up. It is possible that adolescents may have made numerous smaller transitions in between the two annual measurement time points (Collins, 2006). As was indicated in the observed findings, friendship and drinking behaviour during adolescence are not

stable and show considerable variation and there may be specific events that affect peer processes that tend to be short-lived and that may require a shorter follow-up period to capture. However, one of the trade-offs with more frequent follow-ups is that they may bore and burden study participants which contribute to attrition and increase study costs. Despite these possibilities, the present findings are based on a shorter follow-up period than previous studies (see literature review in Section 1.1) and a balance of both stability and change was evident over the year observed.

Findings in the present study were based on self-report, potentially limiting the data available for analysis. One alternative available for studying peer processes is to use social network analysis. In social network analyses, data regarding peer relationships can be collected from each of the peers and linked with data reported by respondents. Thus, more information can be revealed from different perspectives as to whether they are in the same peer network, the qualities of their friendships, behaviours and interactions. In the present study the number of drinking peers was self-reported by participants and there was limited information available as to whether these peers were classmates or same-age peers from outside the school. Moreover, it was also unclear in the present study when adolescents were identified from their self-reports to have transition into peer subgroups with more drinking peers whether they had actually acquired new drinking friends or their existing best friends had started drinking at higher levels. Not-with-standing these potential problems, the data on alcohol use and peer relationships used in the present study was found to show considerable stability (reliability) across time and showed validity in mapping well to many aspects of the PPM that emerged from previous research.

One limitation in statistical analyses was the small odds ratios ($0.95 < OR < 1.05$) in the transition matrixes when estimating the effect of covariates on transitions between latent peer statuses. This may due to the estimation difficulties in LTA with small prevalence in latent statuses. One way to deal with these estimation difficulties is to adopt a binomial logistic regression approach by

estimating the effect of covariates in transitioning to a target latent status at Time 2 relative to all other latent statuses combined as the reference category (Collins & Lanza, 2010). Moreover, the present study utilised a relatively restricted range of covariates examined for associations with cross-sectional and longitudinal latent status groups. Although the covariates included in the present study were selected based on the PPM, future research could usefully consider a wider set of factors.

Despite of these limitations, this thesis made several important contributions to the understanding of the effect of peer processes on adolescent alcohol use. A Peer Process Model (Leung et al., 2011) was developed from a systematic review of previous longitudinal studies and examined findings in relationship to the model predictions. The present study had strengths in observing state-representative samples in three different age groups of adolescence in two nations and in following up samples one-year later, with almost no attrition. Furthermore, the study employs a novel approach using LCA and LTA to identify and longitudinally observe movements between latent subgroups that were identified to be congruent with peer influence and peer selection processes.

The present findings provide a number of potential new insights into the dynamics of peer processes in adolescence including their relative contribution in different age cohorts of adolescents and in cross-national context. The use of LTA models provided a comprehensive and parsimonious way of modelling complex data and for presenting results that could be interpreted against the PPM to shed insight into peer processes in the development of adolescent drinking behaviours. Although the three cohorts of adolescents that were followed longitudinally in each state were discrete panels and not the same group of adolescents who were followed up for 6 years, findings provide insights on the timing for preventive interventions for individuals in different peer groups. Findings also illustrated differential effects of predictors that may be valuable for targeting future intervention strategies.

Findings in the youngest cohort appeared to be especially important for prevention science given that existing studies in the literature that have examined peer processes related to alcohol use among children below the age of 12, are limited. Results shed light on a range of potentially appropriate prevention strategies that may be relevant to guide intervention efforts for early adolescents in this age group. As the early onset of alcohol use is a marker for an increased likelihood of alcohol use disorders and problem behaviours in adolescents and early adulthood (Mason et al., 2011), it is crucial to monitor the prevalence of alcohol use among children and to identify early childhood risk factors for alcohol use onset that can be targeted in prevention programs (Donovan et al., 2004).

7.4 Conclusions

In summary, findings from the present study were found to mainly accord with predictions arising from the Peer Process Model (PPM) that emerged from the comprehensive systematic literature review. This general congruence in findings suggested that the PPM can serve as a useful theoretical guide for examining the relative contribution of peer influence and selection mechanisms that influence the development of alcohol use behaviour through adolescence. The empirical study used Latent Class Analysis to identify characteristics of alcohol use and peer groups in state-representative samples at three different periods of adolescence in Victoria and Washington State. Latent Transition Analysis was applied to model prospective transitions between latent subgroups that were identified to be congruent with peer influence and peer selection processes.

Results from the empirical study provided evidence to support a number of propositions arising from the PPM. The PPM posited that snowball risk factors (indicated by high levels of family risk factors at an early age) would predict early peer selection. The study findings revealed that the higher rates of adolescent alcohol use in Victoria (and the associated higher levels of family risk factors)

were associated with peer selection being only observed in that state. In line with the PPM, early adolescents (Grade 5) were more likely to be using alcohol in the absence of peers (a necessary pre-condition for peer selection) where they had high levels on snowball risk factors. Transitions congruent with early peer selection were predicted by snowball risk factors such as *Family history of antisocial behaviour* and to a lesser extent *Family conflict*. Consistent with the PPM, transitions congruent with peer influence were found to emerge later in adolescence, but were not observed in the youngest adolescent cohorts. In line with the PPM, snowstorm risk processes including the aggregation of alcohol-using peers were observed to increase the risk of transitions that were congruent with peer influence. The results presented in this study tested a number of paths that were identified by the PPM as not having been adequately tested in the previous studies included in the systematic review.

The findings of the present study reveal heterogeneity in the development of alcohol use across early adolescence. These results are useful for quantifying the subgroups of adolescents that may be affected by different peer processes at different points in their development. The detailed findings presented in this thesis can assist to pinpoint the optimal timing for interventions and the high-risk subgroups to be targeted. Resources can be allocated according to the different needs of subgroups of adolescents as opposed to a one-size-fits-all program across all individuals. The findings suggest in particular that prevention efforts should focus in Victoria at reducing alcohol use and early family risks in the Grade 5 and 6 cohort, by Grade 9 the findings suggested that many adolescents in Victoria are drinking heavily with this behaviour reinforced by high numbers of drinkers in peer groups. In contrast, lower rates of alcohol use suggested opportunities for prevention in Washington State remain evident in the Grade 7 and 8 and the Grade 9 and 10 cohorts.

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Appendix A: Ethics Approval

Research Services
(Office of the Deputy Vice-Chancellor (Research) (Melbourne Campus)

MEMORANDUM

TO: Prof. John Toumbourou cc: Rachel Leung
School of Psychology, Geelong Waterfront

FROM: Deakin University Human Research Ethics Committee (DU-HREC)

DATE: 4 May 2009

SUBJECT: **Project EC 29-2009** ***(Please quote this project number in future communication.)***
Identification of factors that can modify peer group influences on adolescent alcohol use

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Interim approval for this project was ratified at the DU-HREC meeting held on 30 March 2009.

Approval has been given for Rachel Leung, under the supervision of Prof. John Toumbourou, School of Psychology, to undertake this project for a period of three years from 24 February 2009.

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

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

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

DU-HREC may need to audit this project as part of the requirements for monitoring set out in the National Statement on Ethical Conduct in Research Involving Humans (1999)

Vicky Bates, Secretary
On behalf of DU-HREC
03 9251 7123

Appendix B: Survey items selected as measures for covariates predicting Time 1 latent peer group membership and transitions between grade levels.

Covariates	Grade 5 & 6	Grade 7 & 8	Grade 9 & 10
Pubertal timing	✓	✓	✓
Scores of the Pubertal Development Scale (PBS) were adjusted by gender within each age group and recoded as a binary variable. Items of the PBS were:			
Response options for the above items were "Has not started yet", "Has barely started", "Has definitely started", "Seems complete", or "I don't know".			
• Would you say that your growth in height (growth spurt)?			
• And how about the growth of your body hair? Would you say that your body hair growth...			
• Have you noticed any skin changes, especially pimples?			
• Have you a deepening of your voice? (male only)			
• Have you begun to grow hair on your face? (male only)			
• Have you noticed that your breasts have begun to grow? (female only)			
• Have you begun to menstruate? (female only)			

Covariates	Grade 5 & 6	Grade 7 & 8	Grade 9 & 10
Family history of antisocial behaviour	✓	✓	✓
Response options for the following items were "No", "Yes", or "I don't have any brothers or sisters"			
• Have any of your brothers or sisters ever: drunk alcohol (like beer, wine or liquor/spirits)? used marijuana (pot, grass, weed)? smoked cigarettes? taken a weapon to school? been suspended or expelled from school?			
• Has anyone in your family ever had a severe (serious) alcohol or drug problem?			
Response options for the following items were "None", "1 adult", or "2 adults", "3 or 4 adults", or "5 or more adults"			
• How many adults (over 21) do you know personally who, in the past year, have… gotten drunk or high? used marijuana (pot, weed, grass), or other illegal drugs? sold drugs? done other things that could get them in trouble with the police like stealing, selling stolen goods, beating someone up, etc.?			

Covariates	Grade 5 & 6	Grade 7 & 8	Grade 9 & 10
Poor family management	✓	✓	✓
Response options for the following items were “No!”, “no”, “yes”, or “Yes!”			
• My parents ask if I've gotten my homework done.			
• My parents would know if I did not come home on time.			
• The rules in my family are clear.			
• When I am not at home, one of my parents knows where I am and who I am with.			
• My parents want me to call if I'm going to be late getting home.			
• My family has clear rules about alcohol and drug use.			
• If you drank some alcohol (like beer, wine, or spirits) without your parents' permission, would you be caught by your parents?			
• If you carried a weapon without your parents' permission, would you be caught by your parents?			
• If you skipped school without your parents' permission would you be caught by your parents?			
Family Conflict	✓	✓	✓
Response options for the following items were “No!”, “no”, “yes”, or “Yes!”			
• We argue about the same things in my family over and over.			
• People in my family have serious arguments.			
• People in my family often insult or yell at each other.			
• We argue about the same things in my family over and over.			
• People in my family have serious arguments.			

Covariates	Grade 5 & 6	Grade 7 & 8	Grade 9 & 10
Parental attitude towards drug use	✓	✓	✓
Response options for the following items were "Very wrong", "Wrong", "A little bit wrong", or "Not wrong at all"			
• How wrong do your parents feel it would be for you to: smoke cigarettes? drink beer or wine regularly (at least once or twice a month)? drink liquor/spirits regularly (at least once or twice a month)? use marijuana (pot, weed, grass)?			
Involvement in clubs	x	✓	✓
Response options for the following items were "Never", "1 or 2 times", "3 to 5 times", "6 to 9 times", "10 to 19 times", "20 to 29 times", "30 to 39 times", "40+ times"			
• How many times in the past year (12 months) have you been involved in sports, clubs, organizations, or other activities at school?			
Opportunities for prosocial involvement in the family	x	✓	✓
Response options for the following items were "No!", "no", "yes", or "Yes!"			
• If I had a personal problem, I could ask my mom or dad for help.			
• My parents give me lots of chances to do fun things with them.			
• My parents ask me what I think before most family decisions affecting me are made.			
• If I had a personal problem, I could ask my mom or dad for help.			

Covariates	Grade 5 & 6	Grade 7 & 8	Grade 9 & 10
Opportunities for prosocial involvement at school	x	✓	✓
Response options for the following items were "No!", "no", "yes", or "Yes!"			
• In my school, students have lots of chances to help decide things like class activities and rules.			
• Teachers ask me to work on special classroom projects.			
• There are lots of chances for students in my school to get involved in sports, clubs, and other school activities outside of class.			
• There are lots of chances for students in my school to talk with a teacher one-on-one.			
• I have lots of chances to be part of class discussions or activities.			

Note: ✓= covariates tested in the respective cohort. x = covariates tested in the respective cohort.

Appendix C: Example syntax to fit LTA models

```
*Final five-status model of self-reported drinking statuses of adolescents and their peers over time in the Victorian Grade 7 and 8 cohort (measurement invariance across two time points);
PROC LTA DATA data=g78_covariates_vic;
NSTATUS 5;
NTIMES 2;
ITEMS g7nofrd g72dfrd g74dfrd g7offer g7alcoo g7binge g7alcur g7aleve
      g8nofrd g82dfrd g84dfrd g8offer g8alcoo g8binge g8alcur g8alpyr;
CATEGORIES 2 2 2 2 2 2 2 2;
MEASUREMENT times;
SEED 331;
RUN;

*Incorporating Grade 7 covariates in the final five-status model to predict Grade 7 latent peer subgroup membership in Victoria (measurement invariance across two time points);
PROC LTA DATA data=g78_covariates_vic   START=g78_param_vic;
NSTATUS 5;
NTIMES 2;
ITEMS g7nofrd g72dfrd g74dfrd g7offer g7alcoo g7binge g7alcur g7aleve
      g8nofrd g82dfrd g84dfrd g8offer g8alcoo g8binge g8alcur g8alpyr;
CATEGORIES 2 2 2 2 2 2 2 2;
MEASUREMENT times;
COVARIATES1 g7sexbin g7ptbin g7fmcon g7faman g7ptald g7fopp g7scopp
            g7fmab g7opbm g7cldrp;
REFERENCE1 1;
BETA PRIOR = 1;
RUN;
```

```
*Incorporating Grade 7 covariates in the final five-status model to predict
transitions between latent peer subgroups from Grades 7 to 8 in Victoria;
PROC LTA DATA data=g78_covariates_vic   START=g78_param_vic;
NSTATUS 5;
NTIMES 2;
ITEMS g7nofrd g72dfrd g74dfrd g7offer g7alcoo g7binge g7alcur g7aleve
        g8nofrd g82dfrd g84dfrd g8offer g8alcoo g8binge g8alcur g8alpyr;
CATEGORIES 2 2 2 2 2 2 2 2;
MEASUREMENT times;
COVARIATES2 g7sexbin g7ptbin g7fmcon g7faman g7ptald g7fopp g7scopp
                g7fmab g7opbm g7cldrp;
REFERENCE2 1 2 3 4 5;
BETA PRIOR = 1;
RUN;
```