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Early-Age Alcohol Use and Later Alcohol Problems in Adolescents: Individual and Peer Mediators in a Bi-National Study

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Abstract

This paper examines whether there is cross-national similarity in the longitudinal relationship between early-age alcohol use and adolescent alcohol problems. Potential mechanisms underlying this relationship also are examined, testing adolescent alcohol use, low self-regulation, and peer deviance as possible mediators. Students (N=1945) participating in the International Youth Development Study, a longitudinal panel survey study, responded to questions on alcohol use and influencing factors, and were followed annually over a three-year period from 2002 to 2004 (98% retention rate). State-representative, community student samples were recruited in grade 7 in Washington State, United States (US, n = 961, 78% of those eligible; M_{age} = 13.09, SD = .44) and Victoria, Australia (n = 984, 76% of those eligible; M_{age} = 12.93, SD = .41). Analyses were conducted using multiple-group structural equation modelling. In both states, early-age alcohol use (age 13) had a small but statistically significant association with subsequent alcohol problems (age 15). Overall, there was little evidence for mediation of early alcohol effects. Low self-regulation prospectively predicted peer deviance, alcohol use, and alcohol problems in both states. Peer deviance was more positively related to alcohol use and low self-regulation among students in Victoria compared to students in Washington State. The small but persistent association of

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early-age alcohol use with alcohol problems across both samples is consistent with efforts to delay alcohol initiation to help prevent problematic alcohol use. Self-regulation was an important influence, supporting the need to further investigate the developmental contribution of neurobehavioral disinhibition.

Keywords

Alcohol use problems; Mediation; Self-regulation; Cross-national; Peers

Relevant studies consistently find that an earlier age of initiation of alcohol use increases subsequent progression to alcohol problems and, eventually, early emerging disorder symptoms (Fergusson, Horwood, & Lynskey, 1995; Guo, Hawkins, Hill, & Abbott, 2001; Hawkins et al., 1997; Hingson, Heeren, & Winter, 2006). As yet, the mechanisms underlying the relationship between early-age alcohol use and adolescent alcohol problems have not been extensively studied. This is an important gap in knowledge, because early alcohol initiation and alcohol problems in adolescence are associated with increased risk for the development of alcohol use disorders throughout the teen years and into adulthood (Clark, Kirisci, & Tarter, 1998; Giaconia et al., 1994; Hingson et al., 2006). A number of perspectives seek to explain the impact of early alcohol use. Stage-sequential theories suggest that the development of alcohol use behaviour progresses through specific stages, beginning with experimental use on intermittent occasions, progressing to more frequent sessions of use with the consequence of progressively heavier consumption due to alcohol habituation (Graham, Collins, Wugalter, Chung, & Hansen, 1991; Guo, Collins, Hill, & Hawkins, 2000). Neurological researchers posit that the use of alcohol and drugs adversely influences brain development and functioning (Medina, Schweinsburg, Cohen-Zion, Nagel, & Tapert, 2007; Tarter et al., 2003; White & Swartzwelder, 2004) and undermines individual self-regulation by adversely influencing impulse control, sensation seeking, and mood processes (Chambers, Taylor, & Potenza, 2003), although such effects can be subtle.

Progression to higher levels of alcohol use has also been successfully modelled on the basis of social influences. The Social Development Model (SDM) and other social process theories posit that influences in the peer group become particularly salient during adolescence (Catalano & Hawkins, 1996; Oetting & Beauvais, 1987; Simons & Robertson, 1989). Association with substance-using and antisocial peers consistently has been identified as one of the strongest predictors of adolescent alcohol use (Hundleby & Mercer, 1987; Mason & Windle, 2001) and alcohol-related problems (Ellickson, Tucker, Klein, & McGuigan, 2001; Guo et al., 2001; Windle, 1996). Early alcohol use may lead to association with deviant peers, which increases, in turn, the likelihood of developing alcohol problems.

This study aimed to investigate whether early-age alcohol use increases the prospective risk of subsequently experiencing alcohol problems directly or indirectly in different country contexts. Three theoretically specified mechanisms were tested as potential mediators: (1) alcohol stage sequential theory, positing mediation via a high level of subsequent alcohol use; (2) self-regulation theory, positing mediation via undermined self regulation; and (3) social process theory, positing mediation via increased peer alcohol use and peer antisocial behaviours.

This study also aimed to contribute to an understanding of the cross-national generalizability of early alcohol use and mediation effects. While there has been some prior investigation of mechanisms influencing progression to adolescent alcohol problems in United States (US) samples (e.g., Lonczak et al., 2001), there is a need for parallel investigations in samples drawn from additional countries. Lonczak et al. (2001) found that social developmental

processes specified by the SDM partially mediated the link between age-14 alcohol use and age-16 alcohol misuse in a sample of adolescents from Seattle, Washington State. The current study extends this and other prior research by examining additional potential mediating mechanisms and by comparing samples from two different country contexts.

Analyses here were based on data from the International Youth Development Study (IYDS), a longitudinal cohort study investigating adolescent development in state-representative samples recruited in Washington State, US, and Victoria, Australia. Schools in the US and Australia differ in their approaches to alcohol and substance use; broadly speaking, US schools adopt a zero-tolerance approach with abstinence as the goal, whereas Australia follows a harm minimization approach focusing on reducing alcohol-related harm rather than alcohol use per se (Evans-Whipp et al., 2004). The legal drinking age also differs in these two country contexts (i.e., age 21 for the US and age 18 for Australia).

Figure 1 displays a conceptual model of pathways leading from early-age alcohol use (measured at age 13) to adolescent alcohol problems (measured at age 15) through the hypothesized mediators (measured at age 14). Based on prior research (e.g., Lonczak et al., 2001), it was expected that processes specified by alcohol-stage-sequential, self-regulation, and social (peer) process theories would at least partially account for the relationship between early-age alcohol use and subsequent alcohol problems. Analyses tested for possible differential alcohol mediation across the two IYDS samples. For example, within the US context of abstinence-based education, there might be weaker links in the alcohol stage sequential process among Washington State compared to Victoria State students. Having repeated assessments of alcohol use, self-regulation, and peer deviance in this longitudinal panel study permitted tests to explore potential bi-directional associations among these variables from age 13 to age 14, and to examine potential mediation of early (age 13) self-regulation and peer deviance effects on later (age 15) alcohol problems.

Method

Study protocols were approved by the University of Washington Human Subjects Review Committee and the Royal Children's Hospital Ethics in Human Research Committee in Melbourne, Australia. Student recruitment used active parental consent procedures.

Participants

Data were collected from 1945 students in Grade 7 from Washington State and Victoria. In 2001–2002, a two-stage cluster approach was used to recruit students in both states. In the first stage, schools were selected at random, based on a probability proportional to grade-level size from a stratified sampling frame of all schools in Victoria (government, Catholic, and independent) and Washington State (public and private). At stage two, single intact classes from each school for the selected grade level were chosen at random. In Victoria, 54 classes in 54 schools (81% of eligible schools, $n = 67$) agreed to participate. In Washington State, 51 classes in 51 schools (71% of those approached, $n = 72$) participated. Analyses generally supported the representativeness of participating schools; compared to the school-aged population of each state, private schools were somewhat underrepresented in the Washington State sample and levels of low-income assistance were somewhat overrepresented in the Victorian sample (McMorris, Hemphill, Toumbourou, Catalano, & Patton, 2007).

Classes in Washington State yielded a total of 1226 eligible students, of whom 961 (78%) consented to and participated in the survey. In Victoria, 1301 students were eligible, of whom 984 (76%) consented and participated. Students were followed up annually for 3 consecutive years with 98% retention in both states.

Males and females were equally represented in the total sample and in each cohort (49% male and 51% female overall and in each state sample). The average age of Victorian students (M = 12.93, SD = .41) was slightly younger than the average age of Washington State students (M = 13.09, SD = .44). In terms of ethnicity, 64.9% of students in Washington State reported they were White, 16.3% Hispanic, 6.3% Asian/Pacific Islander, 6.1% Native American, 3.6% African American, and 2.6% belonged to other ethnic groups, as defined by the investigators. In Victoria, investigators measured ethnicity differently; the majority of students reported that they were Australian (90.6%), 6.0% Asian/Pacific Islander, 1.1% Aboriginal, less than 1% each were African or Spanish, and 1.0% reported other ethnic groups.

Procedures

The protocol for the student survey consisted of a self-report instrument, adapted from an instrument that has shown good reliability and validity in large samples (Glaser, Van Horn, Arthur, Hawkins, & Catalano, 2005). Surveys were administered by trained study staff in classrooms during a 50- to 60-minute period in the winter and spring months of each state's school year in 2002 (to maintain seasonal equivalence). Where possible, students absent from school were followed and surveyed separately. Students in Victoria received a small pocket calculator upon return of their consent forms, while students in Washington State received $10 upon completion of the survey.

Measures

The measures were based on the Communities That Care youth survey, described in previous publications (Glaser et al., 2005). Items were pre-tested in each country with small adaptations made as appropriate to ensure semantic equivalence (McMorris et al., 2007). Analyses included measures of age-13 alcohol use and gender (coded 1 for males and 0 for females), latent variable indicators of the three mediating processes at age 14 (alcohol use, low self-regulation, and peer deviance), and a measure of alcohol problems at age 15. Latent variable indicators of low-self regulation and peer deviance at age 13 also were included in the analyses to permit an examination of rank-order stability and change in these process over time (Windle, 1997). Descriptive statistics for the measures are presented separately by state in Table 1. Prior to analysis, the alcohol problems dependent variable was log transformed to help normalize the distribution (skew reduced from 4.96 to 2.20); skewness for the remaining variables ranged from .034 (gender) to 3.67 (heavy episodic drinking).

Alcohol problems—The study outcome measured at age 15 was the self-reported frequency of alcohol problems over the previous year. Problems were indexed from responses to the following 11 items "When drinking alcohol over the past year, have you ever found that you were not able to stop drinking once you had started?"; "Over the last year how often has your use of alcohol caused you to… Have trouble at school the next day? Get into arguments with your family? Become violent and get into a fight? Have sex with someone which you later regretted? Get injured or to have an accident? Get in trouble with the police? Feel anxious or depressed? Got so drunk you were sick or passed out? Be asked to leave a party, pub or club because you were drunk?", and "How often during the last year have you been unable to remember what happened the night before because you had been drinking?" Responses were scaled as follows: 1 "Never," 2 "1 or 2 times," 3 "3–5 times," 4 "6–9 times," 5 "10–19 times," 6 "20–29 times," 7 "30–39 times," 8 "40 or more times," and then summed (α = .89). One or more alcohol problems were reported by 15% of the students in Washington State and 22% of the students in Victoria at the age 15 follow-up. Self-reports of alcohol problems have been shown to be reliable and valid, especially for the types of highly visible and salient problems assessed in the IYDS (Midanik, 2006).

Age-13 alcohol use—In grade 7, students were asked "In your lifetime on how many occasions (if any) have you had alcoholic beverages (like beer, wine, or liquor/spirits) to drink - more than just a few sips?" Response options ranged from 1 "Never" to 8 "40+ times."

Mediators—Age-14 a*lcohol use* was measured as a latent variable indicated by self-reported alcohol use frequency and heavy episodic drinking. Alcohol use frequency at age 14 was measured using the same question to measure alcohol use at age 13, which is described above, but with reference to the past 12 months. To assess heavy episodic drinking at age 14, respondents were asked "Think back over the last two weeks. How many times have you had five or more drinks in a row?" Response options ranged from 1 "None" to 6 "10 or more times."

Low self-regulation at age 14 was measured as a latent variable indicated by self-reported impulsivity, sensation seeking, and emotional control. An identical latent variable at age 13 was included in the analyses as a control. Impulsivity was the sum of three items rated on a scale ranging from 1 "definitely yes" ("YES!") to 4 "definitely no" ("NO!"). Respondents were asked to indicate the degree to which they rush into things (reverse coded), answer without thinking (reverse coded), and believe it is important to think before acting. The average of alpha reliability calculated at ages 13 and 14 was .60 for Washington State and . 61 for Victoria. Sensation seeking was the sum of three items that asked respondents to indicate the degree to which they had "Done crazy things even if they are a little dangerous," "Done something dangerous because someone dared you to do it," and "Done what feels good no matter what." Response options ranged from 1 "Never" to 6 "Once a week or more." The average of alpha reliability calculated at ages 13 and 14 was .71 for Washington State and .76 for Victoria. Emotional control was the sum of four items rated on a scale ranging from 1 "definitely no" ("NO!") to 4 "definitely yes" ("YES!"). Sample items include "I am always able to keep my feelings under control" and "I control my temper when people are angry with me." The average of alpha reliability calculated at ages 13 and 14 was .77 for Washington State and .73 for Victoria.

Peer deviance at age 14 was measured as a latent variable indicated by self-reported association with antisocial peers and association with substance-using peers. An identical latent variable at age 13 was included in the analyses as a control. Association with antisocial peers was the sum of eight items asking students to indicate how many of their best friends engaged in antisocial activities such as violence and theft in the past year. Response options ranged from 1 "None of my friends" to 4 "4 of my friends." The average of alpha reliability calculated at ages 13 and 14 was .82 for Washington State and .76 for Victoria. Association with substance-using peers was the sum of four items asking students to indicate how many of their best friends smoked cigarettes, tried alcohol without parent's knowledge, used marijuana, or used other illegal drugs in the past year. Response options used the 4-point scale described above, and the average of alpha reliability calculated at ages 13 and 14 was .84 for Washington State and .74 for Victoria.

Analyses

Analyses were conducted using multiple-group structural equation modeling (SEM) in Mplus 5.21 (Muthén & Muthén, 2007). To account for the categorical nature of certain latent variable indicators (e.g., heavy episodic drinking at age 14), parameter estimates were derived using the weighted least squares means-variance (WLSMV) estimator, which also incorporates missing data procedures to maximize the use of available data. Model fit was evaluated using the chi-square statistic; the Tucker-Lewis Index (TLI) and the Root Mean Square Error of Approximation (RMSEA) also were used, with TLI values close to .95 and

RMSEA values between .05 and .08 representing reasonable fit (Browne & Cudeck, 1993; Hu & Bentler, 1999). Model comparisons were conducted using the Difftest option and the statistical significance of indirect effects was examined using the Indirect option in Mplus. Supplemental tests indicated that any potential school effects were negligible; results from analyses accounting for school clustering revealed similar substantive conclusions as those reported below.

Results

Correlations among study variables are presented in Table 2 separately by state. In general, expected patterns of associations were observed, with similar results for Washington State and Victoria. For example, early-age alcohol use at age 13 was positively associated with alcohol use indicators at age 14 and with alcohol problems at age 15 for both states. Indicators of peer deviance had consistent positive associations with the outcome for both states, as did the measures of impulsivity and sensation seeking, whereas negative associations between the repeated measures of emotional control and alcohol problems were less robust. Subsequent analyses examined associations among key constructs within a multivariate, latent variable context, and tested for statistically significant differences across states.

Figure 2 depicts the structural model that was used to address the study hypotheses and reports parameter estimates from the final multiple-group SEM. The final model was obtained in three steps. First, an unconstrained multiple-group SEM was conducted, in which all parameters were freely estimated across the two states (except for factor loadings, which were constrained to equality across groups and over time to ensure a common measurement model). Results showed that the initial model had acceptable fit, χ^2 (54 df, n_{WA} = 961 and n_{VIC} = 984) = 320.79, $p < .01$, TLI = .94, RMSEA = .07, and that the measurement structure was tenable; all factor loadings were statistically significant, with standardized values ranging from |.29| to |.92| for Washington State and |.30| to |.90| for Victoria.

Second, to obtain a constrained multiple-group model, the unconstrained model was reestimated after fixing to equality across states each of the 13 structural path coefficients depicted in Figure 2. Note that the constrained model retained the cross-group and cross-temporal constraints on the factor loadings introduced in the first model and that all remaining parameter estimates were allowed to vary for the two samples (e.g., measurement error variances, exogenous variable variances and covariances, and endogenous variable residual variances and covariances). The fit of this constrained model was compared to that of the unconstrained model. Results showed that the overall fit of the fully constrained model, χ^2 (61 df, n_{WA} = 961 and n_{VIC} = 984) = 378.35, $p < .01$, TLI = .94, RMSEA = .07, was significantly worse than that of the unconstrained model, $\chi^{2\ \mathrm{Diff}}$ (10 df, n_{WA} = 961 and n_{VIC} = 984) = 86.81, $p < .01$. This suggested that certain structural path estimates were significantly different across states.

Third, to examine state differences, modification indices from the fully constrained model were consulted. The cross-state constraint resulting in the largest modification index value was released and the model was reestimated. The reestimated model was then compared to the unconstrained model. This process was repeated until a final partially constrained model was obtained that did not fit significantly worse than the unconstrained model. Through this iterative process, constraints on four path coefficients were released, resulting in the final model depicted in Figure 2. The fit of the final model was acceptable, χ^2 (58 df, n_{WA} = 961 and n_{VIC} = 984) = 329.62, $p < .01$, TLI = .94, RMSEA = .07, and results showed that the decrement in model fit compared to the unconstrained model was statistically

nonsignificant, χ^2 (7 df, n_{WA} = 961 and n_{VIC} = 984) = 10.27, p = .17. Factor loadings from the final model are reported in Table 3.

In Figure 2, unstandardized parameter estimates are presented with standardized estimates in parentheses, first for Washington State and then for Victoria. Note that unstandardized estimates should be the focus of group comparisons. Standardized estimates incorporate information about group-specific standard deviations of the variables; therefore, they can differ across groups even when unstandardized estimates are fixed to equality. This feature makes standardized estimates undesirable for cross-group comparisons, but they are useful for understanding the magnitude of an estimated effect within a group. Path coefficients that were freely estimated across the two states are presented in brackets. Gender was included in the analyses as an additional exogenous variable that was freely correlated with alcohol use, low self-regulation, and peer deviance at age 13 and allowed to predict alcohol use, low-self-regulation, and peer deviance at age 14 as well as alcohol problems at age 15. Results for gender are not presented in order to conserve space (available from the first author). Per standard practice in SEM, measurement errors of the same indicator measured over time were allowed to covary (e.g., age 13 impulsivity with age 14 impulsivity).

Overall, there were more similarities than differences across states. For Washington State and Victoria, there was a significant positive association between the age-13 alcohol use measure and the age-14 alcohol use latent variable. For both states, results showed that low self-regulation was highly stable over time, and low self-regulation at age 13 positively predicted alcohol use as well as peer deviance at age 14. Peer deviance at age 14 positively predicted, in turn, alcohol problems at age 15 for both Washington State and Victoria.

Regarding mediation, the total indirect effect of age-13 alcohol use on adolescent alcohol problems at age 15 was statistically non-significant in both samples. Only the total indirect effect of age 13 self-regulation on age 15 alcohol problems was statistically significant for both states (b = .082, p < .05, β = .28 for Washington State; b = .224, p < .05, β = .64 for Victoria); this total indirect effect was due to significant mediation through age 14 self-regulation (b = .078, p < .05, β = .27 for Washington State; b = .219, p < .05, β = .63 for Victoria) and age 14 peer deviance (b = .022, p < .05, β = .07 for Washington State; b = . 022, p < .05, β = .06 for Victoria).

Interestingly, alcohol use in middle adolescence at age 14 was not predictive of adolescent alcohol problems at age 15; however, in both states there was a small but statistically significant positive association between age-13 alcohol use and later problem drinking.

Three of the four statistically significant state differences in these analyses revealed a consistent pattern, indicating a stronger influence of deviant peer associations on subsequent outcomes for Victoria compared to Washington State. Specifically, the stability of peer deviance was higher and the positive association of peer deviance at age 13 with alcohol use at age 14 was stronger in Victoria than in Washington State. Whereas the predictive relationship between age-13 peer deviance and age-14 low self-regulation was positive in Victoria, it was negative in Washington State. The total indirect effect of age-13 peer deviance on age-15 alcohol problems was statistically significant only for Victoria (b = .046, β = .32, p < .05), with evidence of significant mediation through age-14 peer deviance (b = . 016, β = .11, p < .05) and age-14 self-regulation (b = .039, β = .26, p < .05). Analyses also revealed a stronger positive predictive relationship between age-14 low self-regulation and alcohol problems in Victoria than in Washington State.

Estimated r-square values were .40 for alcohol use at age 14, .63 for low self-regulation at age 14, .46 for peer deviance at age 14, and .18 for alcohol problems at age 15 in Washington State. Likewise, estimated r-square values were .43 for alcohol use at age 14, .

70 for low self-regulation at age 14, .54 for peer deviance at age 14, and .38 for alcohol problems at age 15 in Victoria. Values approaching 1.0 indicate a greater comprehensiveness in model explanatory power.

Discussion

The current analysis presents the first cross-national longitudinal study examining mechanisms in the influence of early exposure to alcohol use (age 13 or earlier) on the development of adolescent alcohol problems (age 15). Contrary to expectations, identified mediators did not explain the effects of early alcohol use on later alcohol problems. It does not appear that the link between early-age alcohol use and subsequent alcohol problems is due to alcohol stage sequential, self-regulation, or social (peer) process theories. Should these results be replicated, other explanations will need to be sought for the impact of early alcohol initiation on subsequent alcohol problems (e.g., school problems and family difficulties).

Although age-13 alcohol use predicted a higher level of age-14 alcohol use, there was no significant (adjusted) effect of age-14 alcohol use on age-15 alcohol problems for students in either Washington State or Victoria. In both the US and Australia, alcohol use typically becomes more normative among youth as they move through adolescence (e.g., Johnston, O'Malley, Bachman, & Schulenberg, 2008). It is possible that such use, even when it is characterized by occasional heavy drinking, is not directly linked to subsequent alcohol problems after accounting for the impact of early onset alcohol use and other influences, such as low self-regulation. Should these results be replicated, this provides evidence that early initiation is a more potent predictor of subsequent alcohol problems than use, and that its effect is not simply due to habituation resulting in higher use at 8th grade (age 14), after initiation. Alternatively, it is possible that middle adolescent alcohol use predicts the development of alcohol problems in late adolescence and early adulthood, when such problems peak in prevalence.

Low self-regulation made important contributions to age-14 alcohol use, age-14 deviant peer involvement, and age-15 alcohol problems, with effects similar in both states. There was relatively little change in self-regulation over the time frame of the study, and age-14 self-regulation was not influenced by age-13 alcohol use. These findings are consistent with theory and research that highlight the triggering role of neurobehavioral disinhibition in individuals' vulnerability to alcohol and other drug use disorders (Tarter et al., 2003). The high stability of self-regulation suggests that it is shaped predominantly by experiences in earlier developmental periods (Gottfredson & Hirschi, 1990).

There appears to be a bidirectional association between low self-regulation and peer deviance. In Victoria, low self-regulation was related to increased association with deviant peers and association with deviant peers was related to increased low self-regulation, and each served as a mediator of the other in leading to age-15 alcohol problems. These processes may have reinforced one another, resulting in an escalation of self-regulation difficulties and deviant peer involvement, increasing, in turn, the risk for problem drinking. The pattern of bidirectional associations was different in Washington State, where peer deviance was a negative predictor of low self-regulation. There may be differences across Victoria and Washington State in the socialization processes and consequences of deviant peer associations; however, this preliminary finding should be viewed with caution. Research that seeks to replicate and extend (e.g., through social network analysis) these findings is needed.

Contrary to expectations derived from social process theories, age-13 alcohol use did not significantly predict increased peer deviance at age 14 in either state sample. This could have been due, in part, to the relatively high stability of peer deviance over time. Alternatively, deviant peer associations may be more likely to precede and predict the emergence of alcohol use than the reverse; selection processes that lead to increased association with deviant peers may begin to operate only after alcohol use becomes more established later in adolescence (e.g., Curran, Stice, & Chassin, 1997; Simons-Morton & Chen, 2006). Peer deviance at age 14 was a positive predictor of alcohol problems at age 15, which supports a growing body of research indicating that deviant peer involvement appears to be a unique risk factor for the progression to alcohol problems (Mason, Hitchings, McMahon, & Spoth, 2010).

Strengths of the current study include a focus on the early development of alcohol problems, very low attrition, carefully defined samples and procedures, and the longitudinal design. A major limitation is that all variables are self-reported, which is especially important since adolescent self-reports of peer behaviours can be biased (Bauman & Ennett, 1996), and some are manifest variables with measurement error. Additionally, it is possible that age-13 alcohol effects may be mediated by factors that were unmeasured in the current study, such as neurological consequences, or that the mediation theories tested in the current study may take a longer time period to yield observable impacts. A longer follow-up may potentially find mediated effects from early-age alcohol use to subsequent alcohol problems. The use of alcohol tends to be infrequent at age 13 and may lead to social consequences, such as arguments with family, once adolescent alcohol use has been detected. However, there is commonly a time lag between adolescent problem behaviours and parent identification of such behaviours (Laird, Pettit, Bates, & Dodge, 2003). It may take two years or longer for parents to identify adolescent alcohol use and enact consequences. It is also possible that early alcohol use requires time to progress through alcohol habituation to the insight that one is “not able to stop drinking once started.” Thus, the infrequent early use of alcohol at age 13 may shape experiences that take more than two years to fully emerge as consequences. Finally, the study sample included only one state from each country and the broader representativeness is unknown.

In conclusion, the current study extends prior research by examining multiple perspectives on the influence of early-age alcohol use and the development of adolescent alcohol problems, with comparisons across state representative samples of students drawn from two countries. Overall, there was little evidence for mediation of the effect of early-age alcohol use on alcohol problems through the theoretically-specified mechanisms. For students in both the US and Australia, low self-regulation played a prominent role in the development of subsequent peer deviance, alcohol use, and alcohol problems. Low self-regulation further served as a mediator of the link between peer deviance and subsequent alcohol problems. Within our multivariate longitudinal framework, this provides supportive evidence for proponents of neurobehavioral disinhibition as a critical triggering factor in the onset of alcohol problems and disorders (Tarter et al., 2003). Results revealed a cross-nationally stable, small but statistically significant influence of early-age alcohol use on alcohol problems. Although expanded analyses are needed, this finding suggests that early alcohol use may be a risk factor increasing the progression to alcohol problems, independently of country context, and is consistent with efforts to delay early alcohol initiation to help prevent problem alcohol use.

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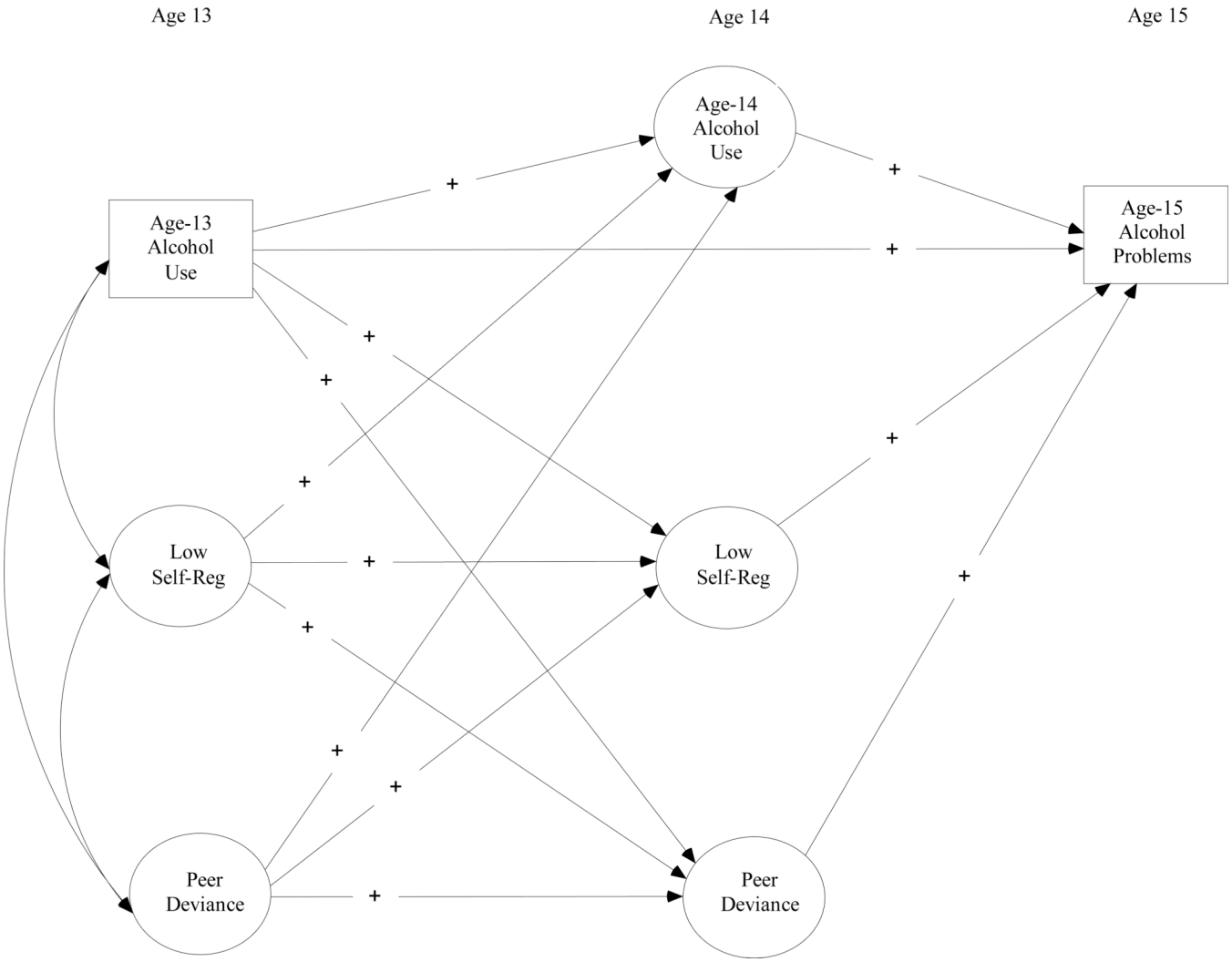

Figure 1.
Conceptual model of pathways leading toward adolescent alcohol problems. + hypothesized positive association.

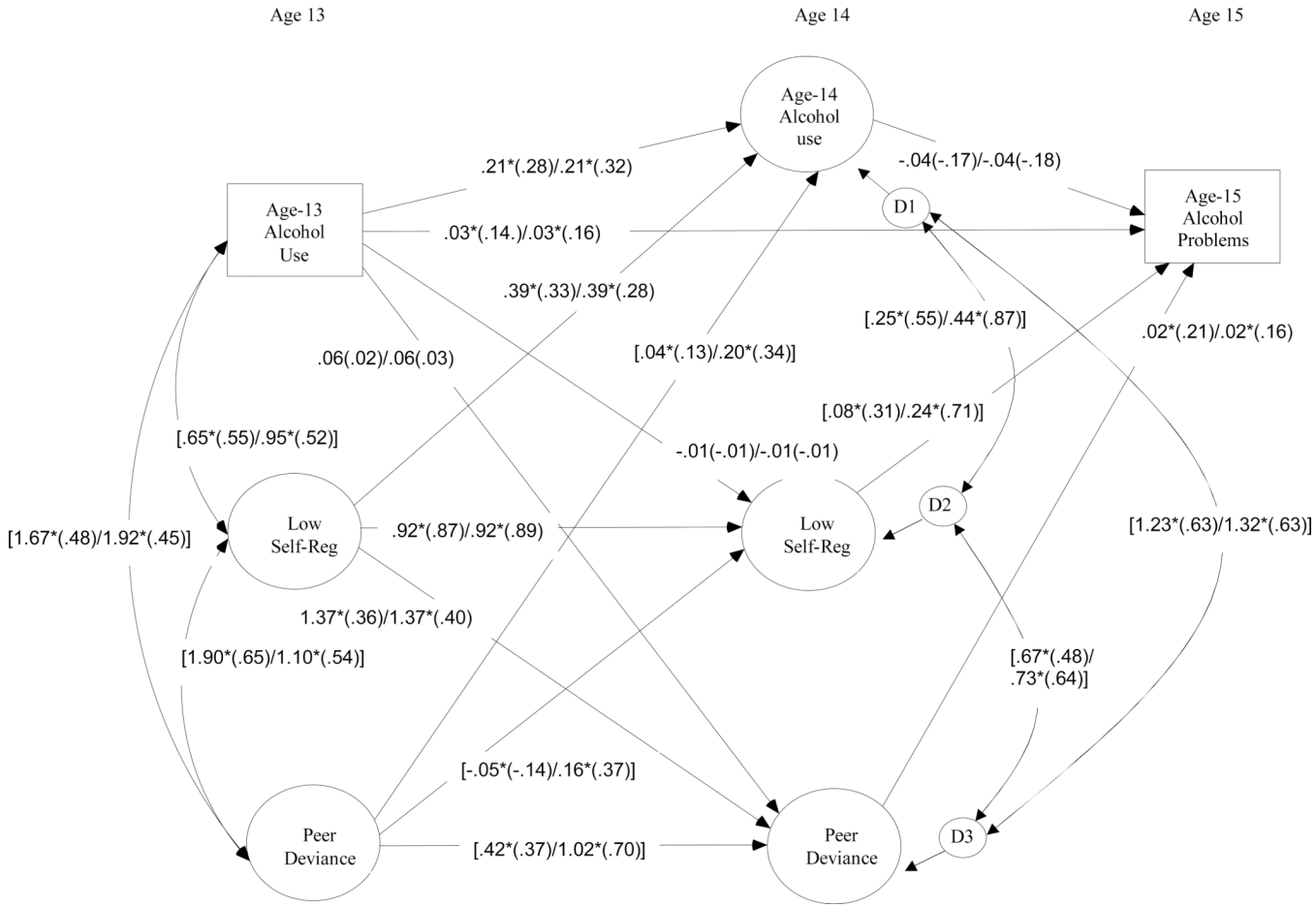

Figure 2.

Multiple-group model of pathways leading toward adolescent alcohol problems in Washington State and Victoria. Unstandardized estimates are presented with standardized estimates in parentheses, first for Washington State and then for Victoria. Path coefficients that were freely estimated across the two states are in brackets. Gender was included as a covariate. Self-reg = self-regulation; * $p < .05$.

Table 1

Descriptive statistics for the study variables by state (n_{WA} = 961; n_{VIC} = 984)

Variable	Washington State			Victoria			Test of state differences
	Observed Range	Mean	SD	Observed Range	Mean	SD	
Age-13 Alcohol use	1–8	1.77	1.35	1–8	2.57	1.98	*
Age-14 Alcohol use frequency	1–8	1.66	1.29	1–8	2.49	1.91	*
Age-14 Heavy drinking	1–6	1.19	.69	1–6	1.35	.89	*
Age-13 Impulsivity	2–11	5.60	1.76	2–12	5.72	1.70	
Age-13 Sensation seeking	2–18	6.40	3.58	2–18	6.28	3.41	
Age-13 Emotional control	4–16	11.00	2.76	3–16	10.68	2.68	*
Age-14 Impulsivity	2–12	5.80	1.78	2–12	6.10	1.77	*
Age-14 Sensation seeking	2–18	7.44	4.02	2–18	7.37	3.97	
Age-14 Emotional control	3–16	10.92	2.74	4–16	10.52	2.50	*
Age-13 Peer antisociality	0–28	2.23	3.88	0–24	1.55	2.66	*
Age-13 Peer drug use	0–16	2.21	3.46	0–16	2.12	2.96	
Age-14 Peer antisociality	0–30	2.76	4.27	0–30	2.50	4.44	
Age-14 Peer drug use	0–16	3.17	4.04	0–16	3.46	3.82	
Age-15 Alcohol problems	10–56	13.83	5.07	7–79	14.29	7.20	

* $p < .05$.

Table 2

Correlations among study variables for Victoria (n = 984; upper-diagonal) and Washington State (n = 961; lower-diagonal)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Gender (Male)		.12*	.05	.07*	.08*	.19*	−.01	.04	.17*	.07*	.14*	.05	.14*	.02	.01
2. Age-13 Alc use	−.04		.47*	.26*	.27*	.42	−.14*	.19*	.34*	−.08*	.32*	.44*	.19*	.36*	.15*
3. Age-14 Alc use frequency	−.06	.45*		.56*	.22*	.31*	−.06	.27*	.46*	−.13*	.26*	.37*	.34*	.48*	.25*
4. Age-14 Heavy drinking	−.03	.22*	.59*		.17*	.27*	−.01	.31*	.41*	−.12*	.35*	.37*	.50*	.51*	.39*
5. Age-13 Impulsivity	.07*	.20*	.15*	.11*		.39*	−.28*	.44*	.33*	−.15*	.26*	.24*	.19*	.20*	.16*
6. Age-13 Sensation seeking	.12*	.39*	.29*	.19*	.28*		−.16*	.27*	.54*	−.09*	.31*	.35*	.26*	.30*	.17*
7. Age-13 Emotional control	.05	−.21*	−.17*	−.05	−.32*	−.18*		−.19*	−.16*	.45*	−.12*	−.11	−.07*	−.08	−.06
8. Age-14 Impulsivity	.06	.21*	.21*	.14*	.39*	.24*	−.21*		.40*	−.27*	.27*	.26*	.36*	.32*	.21*
9. Age-14 Sensation seeking	.20*	.24*	.36*	.29*	.19*	.52*	−.11*	.32*		−.16*	.36*	.39*	.46*	.48*	.30*
10. Age-14 Emotional control	.08*	−.17*	−.14*	−.08*	−.25*	−.12*	.44*	−.27*	−.13*		−.13*	−.13*	−.12*	−.18*	−.14*
11. Age-13 Peer antisociality	.06	.38*	.29*	.22*	.28*	.31*	−.21*	.16*	.19*	−.11*		.65*	.51*	.50*	.20*
12. Age-13 Peer drug use	−.06	.41*	.34*	.21*	.28*	.33*	−.23*	.19*	.22*	−.13*	.70*		.40*	.61*	.22*
13. Age-14 Peer antisociality	.05	.30*	.42*	.43*	.24*	.32*	−.18*	.26*	.36*	−.18*	.53*	.44*		.65*	.39*
14. Age-14 Peer drug use	−.05	.36*	.51*	.45*	.23*	.36*	−.17*	.25*	.39*	−.17*	.40*	.52*	.70*		.35*
15. Age-15 Alc problems	−.05	.31*	.30*	.32*	.24*	.22*	−.25*	.22*	.25*	−.05	.19*	.31*	.37*	.32*	

Alc = Alcohol;

*$p < .05$.

Table 3

Factor loadings from the final structural equation model depicted in Figure 2.

	Washington State			Victoria		
Factor/Indicator	**b**	**SE**	**β**	**b**	**SE**	**β**
Low self-regulation at age 13						
Age-13 Impulsivity	1.00[r]	------	.50	1.00[r]	------	.54
Age-13 Sensation seeking	2.78[*]	0.14	.68	2.78[*]	0.14	.75
Age-13 Emotional control	−0.89[*]	.07	−.28	−0.89[*]	0.07	−.31
Peer deviance at age 13						
Age-13 Peer antisociality	1.00[r]	------	.76	1.00[r]	------	.82
Age-13 Peer drug use	1.07[*]	0.03	.92	1.07[*]	0.03	.79
Alcohol use at age 14						
Age-14 Alcohol use frequency	1.00[r]	------	.79	1.00[r]	------	.68
Age-14 Heavy drinking	0.66[*]	0.03	.67	.66[*]	0.03	.86
Low self-regulation at age 14						
Age-14 Impulsivity	1.00[r]	------	.52	1.00[r]	------	.54
Age-14 Sensation seeking	2.78[*]	0.14	.64	2.78[*]	0.14	.67
Age-14 Emotional control	−0.89[*]	.07	−.30	−0.89[*]	0.07	−.34
Peer deviance at age 14						
Age-14 Peer antisociality	1.00[r]	------	.78	1.00[r]	------	.72
Age-14 Peer drug use	1.07[*]	0.03	.88	1.07	0.03	.89

[r] reference indicator fixed at unity for scaling and identification purposes.

[*] $p < .05$.