BRIEF REPORT: THE RELATIONSHIP BETWEEN PSYCHOLOGICAL DISTRESS AND ADOLESCENT POLYDRUG USE

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Article accepted for publication in: PSYCHOLOGY OF ADDICTIVE BEHAVIORS

Acknowledgements

This study was supported by Australian Research Council Project DP130102015. This funding body had no role in the design, analysis or interpretation of the data. The data on which this study is based were collected as part of the HOWRU Survey, a collaboration between the Centre for Adolescent Health and the Department of Education, Victoria, Australia. The authors thank Prof. John Toumbourou for advice and support relating to this manuscript.

ABSTRACT

Purpose: Polydrug use is relatively common amongst adolescents. Psychological distress is associated with the use of specific drugs, and may be uniquely associated with polydrug use. The purpose was to test the association of psychological distress with polydrug use using a large adolescent sample. **Methods:** The sample consisted of 10,273 students aged 12-17 years of age from the State of Victoria, Australia. Participants completed frequency measures of tobacco, alcohol, cannabis, inhalant, and other drug use in the past thirty days, and psychological distress. Control variables included age, gender, family socioeconomic status, school suspensions, academic failure, cultural background, and peer drug use. Drug use classes were derived using latent class analysis, then the association of psychological distress and controls with drug use classes was modelled using multinomial ordinal regression. **Results:** There were three distinct classes of drug use: *no drug use* (47.7%), *mainly alcohol use* (44.1%), *and polydrug use* (8.2%). Independent of all controls, psychological distress was higher in polydrug users and alcohol users, relative to nondrug users, and polydrug users reported more psychological distress than alcohol users. **Conclusions**: Psychological distress was most characteristic of polydrug users, and targeted prevention outcomes may be enhanced by a collateral focus on polydrug use and depression and/or anxiety.

KEY WORDS: [adolescent, polydrug, drug use, alcohol, tobacco, cannabis, psychological distress]

Amongst adolescents, polydrug use (the use of more than one drug in a specified period) is prevalent. Between 18% (lifetime prevalence in 12-17 year olds; White et al., 2013) and 34% (prior to age 16; Moss, Chen, & Yi, 2014) of adolescents report polydrug use, and prevalence rates appear to have changed little over recent years (Kelly et al., 2014). Most commonly, polydrug use is limited in range (typically alcohol, tobacco, and cannabis; Moss et al., 2014; White et al., 2013), but approximately 1.5% of adolescents engage in extended range polydrug use (the above drugs, inhalants, and/or other illicit drugs) (White et al., 2013). At present, our understanding of the nature of adolescent drug use and its correlates is limited by a frequent reliance on prevalence estimates (present/absent) over comparatively long intervals (lifetime prevalence to one year) (Quek et al., 2013; White et al., 2013). Defined in this way, polydrug use may consist of disparate and potentially low frequency drug use events that have few implications for prevention, beyond those currently recommended for specific drugs. The first aim of this study was to determine the nature and extent of adolescent polydrug use based on drug use frequencies assessed over a relatively short time period.

The second aim of this study was to examine the association of psychological distress (anxiety/depression) and adolescent polydrug use Research on the use of specific drugs points to the importance of adolescent psychological distress as a context for polydrug use. Fleming, Mason, Mazza, Abbott, and Catalano (2008) found that episodic expressions of depression were positively related to adolescent alcohol use. Early adolescent depression predicts levels of alcohol, tobacco and cannabis use amongst girls but not boys (Fleming et al., 2008; Marmorstein, 2010; Saraceno, Heron, Munafò, Craddock, & van den Bree, 2012). The association of depression and alcohol use appears stronger for younger adolescents than older adolescents (Arnold, Greco, Desmond, & Rotheram-Borus, 2014) and it is independent of the autoregressive effects for alcohol use, conduct disorder, academic achievement, and socioeconomic disadvantage (Fleming et al., 2008; Marmorstein, 2010; McCarty et al., 2012; Saraceno et al., 2012). In addition, certain anxiety disorders predict alcohol use over time

(Kaplow, Curran, Angold, & Costello, 2001), and, at least in older adolescents, these effects are significant after controlling for conduct disorder (Zimmermann et al., 2003). Depression and anxiety are predictive of tobacco, cannabis use (Clark, Ringwalt, & Shamblen, 2011; Fuemmeler et al., 2013), and inhalant use (Perron & Howard, 2009), although other research shows inconsistent associations (Fischer, Najman, Williams, & Clavarino, 2012; Moon, Mo, & Basham, 2010). There is also some evidence that the association of anxiety and tobacco use is stronger for girls than boys (Zehe, Colder, Read, Wieczorek, & Lengua, 2013).

There is reason to anticipate that psychological distress may be high amongst adolescent polydrug users. Disengagement from school and poor academic achievement is a common characteristic of polydrug users (Kelly et al., 2015) and this is likely to be related to mood/anxiety problems (Epstein, Botvin, & Doyle, 2009). Also, norms and sanctions against adolescent drug use may mean that adolescent polydrug users have poorer connections with significant others (Kelly et al., 2012). To examine whether psychological distress is elevated in polydrug users, we used latent class analysis (LCA) to identify subgroups of adolescents that had similar profiles of recent drug use, before examining the rates of psychological distress across subgroups. The study improves on many existing population-based LCA studies of polydrug use (Carter et al., 2013; Chung, Kim, Hipwell, & Stepp, 2013; Quek et al., 2013; White et al., 2013) in three ways. First, it utilized frequency data to delineate polydrug classes, rather than prevalence data. Second, the study utilized a more tightly defined assessment window (past month) for assessing drug use than prior studies. Third, the study controlled for known confounds of drug use and/or psychological distress, including age, gender, family affluence, peer drug use, academic failure and school suspensions. The first hypothesis was that psychological distress would be more closely associated with adolescent polydrug use than with other drug use profiles. The second hypothesis was that the association of psychological distress and polydrug use would be more significant for girls than boys.

METHOD

Sample. The initial sample consisted of 10,273 high school students (49.34% male) from Victoria (Australia) who were in Grades 7, 9 and 11 (mean age = 12.51, 14.46 and 16.42 respectively). There was no significant difference between participants from regional and urban areas in terms of age and gender ($p > .05$) but family affluence and country of birth were significantly associated with residency in regional or urban areas ($p < .05$). These factors were fully adjusted in the regression analyses.

A field of 13,501 high school students (Grades 7, 9 and 11) were approached for participation in the study. A passive parental consent and adolescent assent mechanism was used: 739 (5.5%) did not participate because parents declined consent, 37 (0.3%) students declined participation, and 2,047 (15.2%) were absent on the day of testing. A total of 10,678 students participated in the study, of which 405 provided invalid data and were excluded (3.8% of those who participated). The analysis sample was 10,273 (49.3% male). The mean ages were 12.5 (*SD* = 0.6), 14.5 (*SD* = 0.6) and 16.4 (*SD* = 0.6) for Grade 7, 9 and 11 respectively. Of the analysis sample, 307 had more than three missing values for drug use items and were excluded from the LCA. The final sample size was 9,966 (97.0% of the analysis sample). Full information maximum likelihood estimation was used to handle participants with ≤3 missing data points in the LCA. In the final sample, 8.0% had missing data on the independent variable, 1.4% had missing data on two independent variables, and 0.2% had missing data on >3 independent variables. Multiple imputation was used to estimate missing values in the subsequent logistic regression analysis.

Procedure. The parental mechanism varied for state high schools, Catholic schools and Independent Schools. For participating State Schools, approval was also obtained from the Department of Education and Early Child Development, Government of Victoria. For participating schools, two-stage cluster sampling was conducted. For urban schools, the first stage consisted of a stratified random sample of Government, Catholic and Independent schools, with stratification based on the 31

local government areas (LGAs) situated in metropolitan Melbourne. Six schools were sampled from each LGA, except in two which contained 4 and 5 schools respectively. For the latter, all schools within each of the two LGAs were invited to take part. Rural Victoria is divided into five educational regions which were used for the first stage of sampling, with seven schools being randomly selected from each region. In both the urban and rural areas schools were selected randomly with a probability proportional to the number of Year 7, 9 and 11 students enrolled in the school. In the second stage, a random class was selected at each year level (one Year 7, one Year 9 and one Year 11) within each school that agreed to participate. Where schools refused to participate, a school in the same region or LGA was randomly selected to replace the non-participating school whenever possible. The study was approved by the University of Melbourne Research Ethics Committee and the Department of Education, Victoria.

Measures. The measures used in this study were based on the *Communities That Care Youth Survey*, an epidemiological assessment instrument that was developed in the United States (Arthur, Hawkins, Pollard, Catalano, & Baglioni, 2002) and adapted for Australian youth populations (McMorris, Hemphill, Toumbourou, Catalano, & Patton, 2007).

Drug use. Five items were used to measure alcohol, tobacco, marijuana, inhalant and other illegal drug use in the last 30 days. Substances other than alcohol, tobacco, marijuana, and inhalants were not specifically assessed and put into one category ("illegal drugs") because of the negligible use of other substances in Australian adolescent populations (Loxley & Toumbourou, 2004). An example item was "In the last month have you ever had a few sips of an alcoholic beverage (like beer, wine, spirits, or premixed spirits)?" For each drug use item, the response scale was *Never/ 1-2 times/ 3-5 times/ 6-9 times/ 10+ times*. This response scale was recoded into *Never/ 1-2 times/ 3-5 times/ 6+ times* to preserve cell sizes for the LCA.

Psychological distress was measured using the *Kessler Psychological Distress Scale* (K10) (Kessler, Andrews, Colpe, & Hiripi, 2002). Each of the 10 items (e.g., "In the past 4 weeks, about how often did you feel hopeless / nervous / worthless?") are rated using a 5-point Likert scale (*None/A little/Some/Most/All of the time*). To facilitate interpretation of odds ratio estimates, the derived measure for the key analysis was the mean score for the 10 items. The internal reliability of the K10 for the present data set was excellent (Cronbach's $\alpha = 0.90$). While a small number of studies advocate for K10 subscales for depression and anxiety (e.g., Brooks, Beard, & Steel, 2006), more recent population research indicates no empirical basis for a 2-factor structure (Peiper, Clayton, Wilson, & Illback, 2014; Sunderland, Mahoney, & Andrews, 2012). For descriptive purposes, cutoff scores for psychological distress were defined as *low risk* (sum score of 10-15), *medium risk* (16-29) and *high risk* (30-50) (Furukawa, Kessler, Slade, & Andrews, 2003).

Peer drug use was measured with four items "How many of your 4 best friends have smoked cigarettes/ tried alcohol/ used marijuana/ used other illegal drug?" (Cronbach's $\alpha = 0.77$). *Family affluence* was measured with four items from the Health Behaviour in School-Aged Children (HBSC) family affluence scale (Currie et al., 2008) (e.g., "Does your family own a car, van or truck?", "Do you have your own bedroom for yourself?"). Responses were summed and participants with scores 0-2 were coded as "low", 3-5 as "medium", and 6-9 as "high". *Academic failure* was measured with two items: "Putting them all together, what were your marks like last year? *Very good/ Good/ Average/ Poor/ Very poor*" and "Are your school marks better than the marks of most students in your class? (*Definitely yes/Yes/ No/ Definitely No*). Questions also assessed any instance of school suspension (mandatory exclusion from school; yes/no), and country of birth (recoded as Australia/overseas).

Analysis. The LCA was based on frequencies of drug use for each of the five drug categories. There is no single approach that is generally accepted for determining the number of classes for LCA (Nylund, Asparouhov, & Muthén, 2007), so criteria included the Sample Size Adjusted Bayesian

Information Criteria (SSABIC) (Sclove, 1987) and the Lo-Mendell-Rubin likelihood ratio test (LMR-LRT) (Lo, Mendell, & Rubin, 2001). Because the robustness and utility of a given class is likely to be low when the size of a class is small, the solution was required to have a minimum class size of 1% (Quek et al., 2013; White et al., 2013). Average posterior probabilities were used to evaluate classification quality (Muthen & Muthen, 2011).

Model fitting began with a two-class solution and was successively increased to five classes, using Mplus Version 6.01 (Muthen et al., 2011). Since drug use was measured on a 4-point scale, the responses for each drug were specified as ordered categorical in the LCA. Based on previous research, a "No drug use" class was specified a-priori by fixing the probability of using each drug as zero (Connell, Gilreath, Aklin, & Brex, 2010). Once the optimal number of classes was determined, class membership was imputed based on the posterior distribution obtained by the LCA model (Clark & Muthén, 2009). Fifty datasets were imputed and models were estimated using Rubin's multiple imputation technique (Clark et al., 2009; Rubin, 1987). Since the average posterior probability of the final solution was high (> 0.80; see *Results*), it was deemed that the class separation was large in the present study. Among the analysis sample, 956 participants had one or more missing values on variables other than drug use, and these missing values were filled in by multiple imputation when the class membership was imputed. LCA class membership was regressed on to psychological distress in a multinomial logistic regression, controlling for age, gender, family affluence, education sector, born overseas, academic failure, and school suspension.

RESULTS

LCA fit statistics are presented in Table 1a. The four-class and five-class models did not yield a convergent solution so these were rejected. The SSABIC from the three-class model was lower than that from the two-class model. Results from the LMR likelihood ratio test indicated that a three-class model fitted the data significantly better than a two-class model. Given that all the classes in the three-

class model had sufficient class size, and the average posterior probability was high (see Table 1b), the three-class model was chosen as the optimal model.

The three classes were labeled based on the probabilities for the three most frequently used drugs (Alcohol, tobacco and cannabis) within each class (Table 2). The probabilities of using inhalant and other illicit drug were low and so are omitted from the table and briefly described next. Class 3 *('Polydrug use'*) had a prevalence of 8.2%. The majority of participants in this class had high probabilities of using alcohol (0.96) and tobacco (0.92); a moderate probability of using marijuana (0.48) and a small probability of using other illegal drugs (0.13). Class 2 ("*Mainly alcohol use")* had a prevalence of 44.1%. Participants in this class had a moderate-to-high probability of using alcohol (0.65), a small probability of using tobacco (0.10), and a negligible probability of cannabis, inhalant and other illicit drug use. The estimated prevalence of this class was 44.1%. Class 1 "*No drug use"* was specified a-priori (zero probabilities for each drug category), and the estimated prevalence was 47.7%.

[INSERT TABLES 1a, 1b, and 2 ABOUT HERE]

Table 3 shows the estimated prevalence of polydrug use class by psychological distress categories. For the non-user class, 11.39% were at high risk of psychological distress and this percentage increased to 27.21% for polydrug users. The results of the multinomial logistic regression are presented in Table 4. With reference to the non-user class, participants with higher level of psychological distress were more likely to be in the mainly alcohol class ($OR = 1.15$, $p < .001$), and the polydrug class ($OR = 1.37$, $p < .001$). With reference to the alcohol class, participants with higher level of psychological distress were more likely to be in the polydrug class ($OR = 1.20$, $p < .01$). Given that psychological distress was scaled from 1 to 5 and these *ORs* represent the increase in odds for every unit increase in psychological distress, these *ORs* indicate a moderate to large effect size. The interaction of gender and psychological distress was non-significant ($p > .05$), and was removed from

the final model. These results were fully adjusted for controls. Compared to mainly alcohol use, polydrug use was also positively associated with age, academic failure, peer drug use, and school suspension. Compared to adolescents with high family affluence, adolescents with low family affluence were more likely to be polydrug users than mainly alcohol users. Although the amount of missing data was relatively low, an additional analysis was performed with complete cases only – results were very similar to the imputed results, and all conclusions remained the same.

[INSERT TABLES 3 AND 4 ABOUT HERE]

DISCUSSION

Relative to other groups, polydrug users (8.2% of the sample) were best characterised by elevations in tobacco, alcohol, and cannabis use (modal reports of 6+ occasions of alcohol/tobacco use and 1-2 occasions of cannabis use in the past month). Those who used mainly alcohol (44.1% of the sample) reported a modal frequency of 1-2 occasions per month of alcohol use, and use of other substances/drugs was rare. The proportion of polydrug users in the present study appeared lower than in a Australian nationally representative sample (White et al., 2013), but this is unsurprising given that prevalence rates were operationalized differently (30 day versus lifetime). The proportion of polydrug users was also lower than in a large LCA study of 12th Grade Pennsylvanian students (18% recent use of alcohol/tobacco/cannabis; Cleveland, Collins, Lanza, Greenberg, & Feinberg, 2010), which is, at least in part, probably because of the narrower age range and older sample in Cleveland et als. study. The hypothesis that psychological distress is related to polydrug use more than other classes was confirmed. In particular, psychological distress was higher for polydrug users than mainly alcohol users, and this effect was significant after controlling for likely confounds. There was no evidence of gender differences in the association of psychological distress and polydrug use.

The cross-sectional nature of the study precludes conclusions about causality. However, we cautiously offer some feasible interpretations. First, polydrug users may use drugs in a systematic

and/or synergistic way to manage psychological distress (e.g., to improve mood, escape stress). This would be consistent with prior research on the selective use of drugs for management of negative states (Audrain-McGovern et al., 2012; Clark et al., 2011) and empirical literature on the role of expectancies (personal beliefs) about the consequences of drug use (Connor, George, Gullo, Kelly, & Young, 2011). Furthermore, for some adolescents, drug use may contribute to psychological distress, through its impact on peer and family relationships and school performance. The likelihood seems low that polydrug users experienced psychological distress because of severe drug problems or dependence. Polydrug users reported comparatively low frequencies of cannabis use and a substantial proportion of polydrug users did not report highly regular alcohol consumption (Table 3). Finally, additional common factors may drive both polydrug use and psychological distress, and the present results go some way towards ruling out some of the potential factors that have previously been noted. For example, some adolescents by virtue of genetic and/or social learning, may have predispositions towards 'anticonventionality' (Kandel, Davies, Karis, & Yamaguchi, 1986). These may drive a cluster of problems, including polydrug use, engagement with drug using peers, and school disengagement. The findings are consistent with this, but psychological distress remained a significant predictor of polydrug use independent of these other factors.

The findings have potential implications for prevention and targeted intervention. For adolescents contravening school drug policies, psychological distress should be routinely assessed. For adolescents presenting with depression/anxiety, polydrug-focused assessment may be a useful adjunct. That social disadvantage was weakly and inconsistently associated with polydrug use points to the risks of ignoring polydrug use in adolescents from wealthier backgrounds (Luthar, 2003). While beyond the scope of these data, psychological distress and/or alcohol use may increase the probability of transitions to polydrug use (Kirby & Barry, 2012). If this is the case, a universal prevention focus on alcohol use may be an important way of limiting transitions to polydrug use amongst vulnerable

students. Probabilities of tobacco use were a notable feature of polydrug use profiles and very low in those who mainly used alcohol. Polydrug using adolescents may be resistant to public health initiatives to prevent tobacco smoking, and addressing broader drug using profiles may be an important adjunct for school-based indicated prevention.

Strengths of the study include its large sample size, its depiction of classes based on frequencies of drug use (rather than prevalence), the use of a shorter assessment window (one month) than several earlier studies, and its statistical control of several feasible confounds. While the present study extends extant LCAs utilizing prevalence data via its focus on frequencies of drug use, further research is needed on the extent to which other indices of drug use severity (quantity consumed per occasion, drug problems, dependence) are associated with psychological distress. In contrast to what might be expected from prior research showing gender effects in the association of depressed mood and drug use, this study found no evidence of gender effects in the association of psychological distress and polydrug use. To investigate the specific associations between depression/anxiety and polydrug use, further research may utilize dedicated measures of depression/anxiety. The variable *school suspensions* is a limited proxy for antisocial behavior - further research might employ a more direct and reliable measure. By virtue of pathways to participation (Kelly & Halford, 2007), adolescents with severe distress and/or substance abuse may be under-represented, and given the sampling method those who had dropped out of school could not be recruited. The study relies on self-report.

CONCLUSION

Polydrug users are at elevated risk of psychological distress, and this effect was independent of known strong predictors, including academic performance, school problems, and affiliation with drug using peers. Evidence-based ways of addressing psychological distress may be an important component of early intervention programs for polydrug users.

Table 1a.

Fit statistics from the latent class analysis.

Class	AIC	BIC	SSABIC	LMR-LRT	Average posterior probabilities
2	35544.592	35659.90	35609.06	< .001	0.96
3*	33784.10	34014.72	33903.03	< .001	0.84
4 [a]	33657.33	34003.26	33850.72	1.00	0.76
5 [a]	33564.24	34025.49	33822.10	0.97	0.86

Notes. * The 3-class model was selected as the optimal model. [a] The 4-class and 5-class models did not yield convergent solutions.

Table 1b.

Average latent class probabilities for most likely latent class membership (Row) by latent class (Column).

	Non-user	Mainly alcohol	Polydrug
Non-user	0.782	0.218	0
Mainly alcohol	0	0.954	0.046
Polydrug	0	0.108	0.892

Table 2.

Probabilities of the most frequently used drugs by class membership, based on the 3-class model.

	Class 1 Non-user (47.7%)	Class 2 Mainly alcohol (44.1%)	Class 3 Polydrug (8.2%)
Alcohol			
Never	1.0	0.35	0.04
1-2 times	0	0.44	0.16
3-5 times	0	0.14	0.28
6+ times	0	0.08	0.52
Tobacco			
Never	1.0	0.90	0.08
1-2 times	0	0.06	0.18
3-5 times	0	0.02	0.13
6+ times	0	0.02	0.62
Marijuana			
Never	1.0	0.99	0.52
1-2 times	0	0.01	0.3
3-5 times	0	0	0.07
6+ times	0	0	0.11

Table 3.

Polydrug class by psychological distress categories.

	Class 1	Class 2	Class 3
Psychological distres	Non-user	Mainly alcohol	Polydrug
No or low risk	1775 (36.67%)	1234 (27.53%)	139 (16.8%)
Medium risk	2515 (51.94%)	2543 (56.73%)	465 (55.99%)
High risk	552 (11.39%)	706 (15.75%)	226 (27.21%)
	830 (100%)	4842 (100%)	4483 (100%)

Note. For descriptive purposes, continuous scores were recorded as no or low risk (K10 total of 10-15), medium risk (16-29), and high risk (30+).

Table 4.

Predictors of Class 2 (mainly alcohol) and Class 3 (polydrug use) relative to Class 1 (non-users), and Class 3 relative to Class 2.

Reference	Class 1 (Non-user)				Class 2	
Comparator	Class 2 (Mainly alcohol)		Class 3 (Polydrug)		Class 3	
	OR	95% CI	*OR*	95% CI	*OR*	95% CI
Age	1.11***	(1.07, 1.15)	1.37***	(1.26, 1.49)	1.24***	(1.14, 1.34)
Female	1.08	(0.96, 1.2)	1.12	(0.89, 1.41)	1.04	(0.84, 1.29)
Family affluence (Ref: High)						
Low	0.72	(0.41, 1.23)	1.63	(0.78, 3.4)	2.27*	(1.17, 4.44)
Medium	0.87*	(0.77, 0.98)	0.96	(0.75, 1.23)	1.10	(0.87, 1.38)
Born overseas	0.74**	(0.62, 0.88)	0.58**	(0.4, 0.83)	0.78	(0.55, 1.11)
Academic failure	1.23***	(1.13, 1.34)	1.76***	(1.52, 2.03)	1.42***	(1.24, 1.64)
School suspension	1.44**	(1.15, 1.8)	3.40***	(2.48, 4.67)	2.36***	(1.81, 3.09)
Peer drug use	2.51***	(2.3, 2.74)	7.26***	(6.36, 8.28)	2.89***	(2.59, 3.22)
Psychological distress	**1.15*** **	**(1.07, 1.23)**	**1.37*** **	**(1.21, 1.56)**	**1.20** **	**(1.06, 1.36)**

Notes. ***$p < .001$; **$p < .01$; *$p < .05$.

REFERENCES

Arnold, E. M., Greco, E., Desmond, K., & Rotheram-Borus, M. J. (2014). When life is a drag: Depressive symptoms associated with early adolescent smoking. *Vulnerable Child and Youth Studies, 9*, 1-9. 10.1080/17450128.2013.797129

Arthur, M. W., Hawkins, J. D., Pollard, J. A., Catalano, R. F., & Baglioni, A. (2002). Measuring risk and protective factors for use, delinquency, and other adolescent problem behaviors. *Evaluation Review, 26*(6), 575-601.

Audrain-McGovern, J., Rodriguez, D., Rodgers, K., Cuevas, J., Sass, J., & Riley, T. (2012). Reward expectations lead to smoking uptake among depressed adolescents. *Drug and Alcohol Dependence, 120*(1-3), 181-189. 10.1016/j.drugalcdep.2011.07.020

Brooks, R. T., Beard, J., & Steel, Z. (2006). Factor structure and interpretation of the K10. *Psychological Assessment, 18*(1), 62-70. 10.1037/1040-3590.18.1.62

Carter, J. L., Strang, J., Frissa, S., Hayes, R. D., SELCoH, Hatch, S. L., & Hotopf, M. (2013). Comparisons of polydrug use at national and inner city levels in England: Associations with demographic and socioeconomic factors. *Annals of Epidemiology, 23*, 636-645.

Chung, T., Kim, K. H., Hipwell, A. E., & Stepp, S. D. (2013). White and black adolescent females differ in profiles and longitudinal patterns of alcohol, cigarette, and marijuana use. *Psychology of Addictive Behaviors, 27*(4), 1110-1121. 10.1037/a0031173

Clark, H. K., Ringwalt, C. L., & Shamblen, S. R. (2011). Predicting adolescent substance use: The effects of depressed mood and positive expectancies. *Addictive Behaviors, 36*(5), 488-493. 10.1016/j.addbeh.2011.01.018

Clark, S. L., & Muthén, B. (2009). Relating latent class analysis results to variables not included in the analysis. *Submitted for publication*.

Cleveland, M. J., Collins, L. M., Lanza, S. T., Greenberg, M. T., & Feinberg, M. E. (2010). Does individual risk moderate the effect of contextual-level protective factors? A latent class analysis of substance use. *Journal of Prevention & Intervention in the Community, 38*(3), 213-228. 10.1080/10852352.2010.486299

Connell, C., Gilreath, T., Aklin, W., & Brex, R. (2010). Social-Ecological Influences on Patterns of Substance Use Among Non-Metropolitan High School Students. *American Journal of Community Psychology, 45*(1), 36-48. 10.1007/s10464-009-9289-x

Connor, J. P., George, S. M., Gullo, M., Kelly, A. B., & Young, R. M. (2011). A prospective study of alcohol expectancies and self-efficacy as predictors of young adolescent alcohol misuse. *Alcohol and Alcoholism, 46*, 161-169.

Currie, C., Molcho, M., Boyce, W., Holstein, B., Torsheim, T., & Richter, M. (2008). Researching health inequalities in adolescents: the development of the Health Behaviour in School-Aged Children (HBSC) family affluence scale. *Social Science & Medicine, 66*(6), 1429-1436.

Epstein, J. A., Botvin, G. J., & Doyle, M. (2009). Gender-specific effects of social influences and competence on lifetime poly-drug use among inner-city adolescents. *Journal of Child & Adolescent Substance Abuse, 18*(3), 243-256. 10.1080/10678280902973260

Fischer, J. A., Najman, J. M., Williams, G. M., & Clavarino, A. M. (2012). Childhood and adolescent psychopathology and subsequent tobacco smoking in young adults: Findings from an Australian birth cohort. *Addiction, 107*(9), 1669-1676. 10.1111/j.1360-0443.2012.03846.x

Fleming, C. B., Mason, W. A., Mazza, J. J., Abbott, R. D., & Catalano, R. F. (2008). Latent growth modeling of the relationship between depressive symptoms and substance use

during adolescence. *Psychology of Addictive Behaviors, 22*(2), 186-197. 10.1037/0893-164x.22.2.186

Fuemmeler, B., Lee, C.-T., Ranby, K. W., Clark, T., McClernon, F. J., Yang, C., & Kollins, S. H. (2013). Individual- and community-level correlates of cigarette-smoking trajectories from age 13 to 32 in a U.S. population-based sample. *Drug and Alcohol Dependence, 132*(1-2), 301-308. 10.1016/j.drugalcdep.2013.02.021

Furukawa, T. A., Kessler, R. C., Slade, T., & Andrews, G. (2003). The performance of the K6 and K10 screening scales for psychological distress in the Australian National Survey of Mental Health and Well-Being. *Psychological Medicine, 33*(2), 357-362.

Kandel, D. B., Davies, M., Karis, D., & Yamaguchi, K. (1986). The consequences in young adulthood of adolescent drug involvement: An overview. *Archives of General Psychiatry, 43*, 746-754.

Kaplow, J. B., Curran, P. J., Angold, A., & Costello, E. J. (2001). The prospective relation between dimensions of anxiety and the initiation of adolescent alcohol use. *Journal of Clinical Child Psychology, 30*(3), 316-326. 10.1207/s15374424jccp3003_4

Kelly, A. B., Chan, G. C. K., White, A., Saunders, J. B., Baker, P. J., & Connor, J. P. (2014). Is there any evidence of changes in patterns of concurrent drug use among young Australians (18-29 years) between 2007 and 2010? *Addictive Behaviors, 39*, 1249-1252.

Kelly, A. B., Evans-Whipp, T. J., Smith, R., Chan, G. C. K., Toumbourou, J. W., Patton, G. C., . . . Catalano, R. F. (2015). Adolescent polydrug use and high school noncompletion: A longitudinal study. *Addiction*. 10.1111/add.12829

Kelly, A. B., & Halford, W. K. (2007). Responses to ethical challenges in conducting research with Australian adolescents. *Australian Journal of Psychology, 59*(1), 24-33. 10.1080/00049530600944358

Kelly, A. B., O'Flaherty, M., Toumbourou, J. W., Homel, R., Patton, G. C., White, A., & Williams, J. (2012). The influence of families on early adolescent school connectedness: evidence that this association varies with adolescent involvement in peer drinking networks. *Journal of Abnormal Child Psychology, 40*, 437-447. 10.1007/s10802-011-9577-4

Kessler, R. C., Andrews, G., Colpe, L. J., & Hiripi, E. (2002). Short screening scales to monitor population prevalences and trends in nonspecific psychological distress. *Psychological Medicine, 32*, 959–976.

Kirby, T., & Barry, A. E. (2012). Alcohol as a gateway drug: A study of US 12th graders. *Journal of School Health, 82*(8), 371-379.

Lo, Y., Mendell, N. R., & Rubin, D. B. (2001). Testing the number of components in a normal mixture. *Biometrika, 88*(3), 767.

Loxley, W., & Toumbourou, J. W. (2004). The prevention of substance use, risk, and harm in Australia: A review of the evidence. Canberra: Australian Government Department of Health and Ageing.

Luthar, S. S. (2003). The culture of affluence: Psychological costs of material wealth. *Child Development, 74*, 1581-1593.

Marmorstein, N. R. (2010). Longitudinal associations between depressive symptoms and alcohol problems: The influence of comorbid delinquent behavior. *Addictive Behaviors, 35*, 564-571. 10.1016/j.addbeh.2010.01.004

McCarty, C. A., Wymbs, B. T., King, K. M., Mason, W. A., Vander Stoep, A., McCauley, E., & Baer, J. (2012). Developmental consistency in associations between depressive symptoms and alcohol use in early adolescents. *Journal of Studies on Alcohol and Drugs, 73*(3), 444-453.

McMorris, B. J., Hemphill, S. A., Toumbourou, J. W., Catalano, R. F., & Patton, G. C. (2007). Prevalence of substance use and delinquent behavior in adolescents from Victoria, Australia and Washington State, United States. *Health education & behavior, 34*(4), 634-650.

Moon, S. S., Mo, B. C., & Basham, R. (2010). Adolescent depression and future smoking behavior: A prospective study. *Child & Adolescent Social Work Journal, 27*(6), 405-422. 10.1007/s10560-010-0212-y

Moss, H. B., Chen, C. M., & Yi, H. (2014). Early adolescent patterns of alcohol, cigarettes, and marijuana polysubstance use and young adult substance use: Outcomes in a nationally representative sample. *Drug and Alcohol Dependence, 136*, 51-62. 10.1016/j.drugalcdep.2013.12.011

Muthen, B. O., & Muthen, L. C. (2011). *Mplus Version 6.01*. Los Angeles: Muthen and Muthen.

Nylund, K. L., Asparouhov, T., & Muthén, B. O. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Structural Equation Modeling, 14*(4), 535-569.

Peiper, N., Clayton, R., Wilson, R., & Illback, R. (2014). The Performance of the K6 Scale in a Large School Sample. *Psychological Assessment*, No Pagination Specified. 10.1037/pas0000025

Perron, B. E., & Howard, M. O. (2009). Adolescent inhalant use, abuse and dependence. *Addiction, 104*(7), 1185-1192. 10.1111/j.1360-0443.2009.02557.x

Quek, L.-H., Chan, G. C. K., White, A., Connor, J. P., Baker, P., Saunders, J. B., & Kelly, A. B. (2013). Concurrent and simultaneous polydrug use: latent class analysis of an Australian nationally representative sample of young adults. *Frontiers in Public Health, 61*, doi:10.3389/fpubh.2013.00061

Rubin, D. B. (1987). Multiple imputation for nonresponse in surveys (Vol. 519): Wiley Online Library.

Saraceno, L., Heron, J., Munafò, M., Craddock, N., & van den Bree, M. B. M. (2012). The relationship between childhood depressive symptoms and problem alcohol use in early adolescence: Findings from a large longitudinal population-based study. *Addiction, 107*(3), 567-577. 10.1111/j.1360-0443.2011.03662.x

Sclove, S. L. (1987). Application of model-selection criteria to some problems in multivariate analysis. *Psychometrika, 52*(3), 333-343.

Sunderland, M., Mahoney, A., & Andrews, G. (2012). Investigating the factor structure of the Kessler Psychological Distress Scale in community and clinical samples of the Australian population. *Journal of Psychopathology and Behavioral Assessment, 34*(2), 253-259. 10.1007/s10862-012-9276-7

White, A., Chan, G. C. K., Quek, L. H., Connor, J. P., Baker, P., Saunders, J. B., & Kelly, A. B. (2013). The topography of multiple drug use among adolescent Australians: Findings from the National Drug Strategy Household Survey. *Addictive Behaviors, 38*(4), 2038-2073.

Zehe, J. M., Colder, C. R., Read, J. P., Wieczorek, W. F., & Lengua, L. J. (2013). Social and generalized anxiety symptoms and alcohol and cigarette use in early adolescence: The moderating role of perceived peer norms. *Addictive Behaviors, 38*(4), 1931-1939. 10.1016/j.addbeh.2012.11.013

Zimmermann, P., Wittchen, H. U., Höfler, M., Pfister, H., Kessler, R. C., & Lieb, R. (2003). Primary anxiety disorders and the development of subsequent alcohol use disorders: A 4-year community study of adolescents and young adults. *Psychological Medicine, 33*(7), 1211-1222. 10.1017/s0033291703008158