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EMPIRICAL RESEARCH

Participation in Organized Activities Protects Against Adolescents' Risky Substance Use, Even Beyond Development in Conscientiousness

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Abstract Adolescents are at a significant risk for binge drinking and illicit drug use. One way to protect against these behaviors is through participation in extracurricular activities. However, there is a debate about whether highly conscientious adolescents are more likely to participate in activities, which raises the concern of a confound. To disentangle these relationships, we tested the latent trajectories of substance use and personality across 3 years, with participation in activities and sports as time-varying predictors. We surveyed 687 adolescents (55 % female, 85.4 % Caucasian) in Western Australia schools across 3 years. At Time 1, the students were in Year 10 1 (mean age 15 years). The results showed that participation in activities and conscientiousness are related, but each uniquely predicts slower growth in substance use. Across waves, participation in activities predicted less risky substance use a year later, over and above conscientiousness development. These results suggest that there may be unique benefits of participation in activities that protect against risky substance use.

Keywords Binge drinking · Substance use · Risk behavior · Extracurricular activities · Conscientiousness · Personality development

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Introduction

Risky substance use, including excessive drinking and illicit drug use, is a pressing problem facing adolescents in the United States and abroad. In the United States, 21 percent of adolescents report binge drinking in the last 30 days (Centers for Disease Control and Prevention 2014). These rates are similar in Australia, where 16 percent of adolescents report binge drinking on a monthly basis (Australian Institute of Health and Welfare 2014). Further, illicit drug use is common during the teenage years. Illustratively, 16 percent of U.S. teenagers reported using an illicit drug within the last month (National Center for Health Statistics 2015), and 17 percent of Australian teenagers report doing so within the last month (Australian Institute of Health and Welfare 2014). The long-term health consequences of engaging in these behaviors during adolescence can be severe, and the effects of continued and escalating substance use during adolescence include an increased risk for substance dependence, mental health issues, and antisocial behavior in the second and third decades of life (Brown et al. 2008; Odgers et al. 2008).

One possible pathway for preventing risky substance use among adolescents is through increased exposure to positive social environments. For instance, the time spent in organized activities, such as school clubs or community activities, has been shown to decrease risk behavior during adolescence (Eccles and Barber 1999; Feldman and Matjasko 2005; Fredricks and Eccles 2008; Mahoney 2000). In particular, early exposure to these positive environments appears to deflect youth away from a problematic developmental course (Modecki et al. 2014). While the role of activity contexts in diminishing risk is supported by previous research, personality could provide an alternative explanation for this relationship. Specifically, conscientiousness

differences predict decreased risky behavior and substance use over the lifespan (Bogg and Roberts 2004), and conscientious adolescents also tend to be task-oriented and drawn to academic pursuits (Noftle and Robins 2007; O'Connor and Paunonen 2007). Thus, it may be the case that adolescents who spend time in extracurricular contexts are simply more conscientious than their non-participating peers and, as a result, engage in less risky behavior. In the current study, we aim to disentangle the potential confounding effect of personality in the relationship between activities and adolescent binge drinking and substance use. To achieve this aim, we test two fundamental questions. First, we test whether conscientiousness is related to participation in activities among adolescents. Second, we examine whether participating in activities is associated with lower risky substance use, above and beyond any change in adolescents' risky substance use and the development of conscientiousness.

Adolescent Extracurricular Activities and Risky Behavior

There are significant health concerns associated with adolescents' dangerous substance use, and early exposure to drugs and alcohol appear to pose an especially critical risk for youth. For example, early exposure predicts future substance abuse, dependence, and social problems in adulthood (Brown et al., 2008). In fact, Odgers et al. (2008) found that adolescents who were exposed to alcohol by age 15 were more likely to have substance dependence in later adulthood. Beyond exposure, assessing developmental change in risky substance use is important because it is associated with suppressed age-typical maturation. For instance, increasing substance use across mid-to-late adolescence is associated with declines in psychosocial factors such as perspective taking and resistance to peer influence (Chassin et al. 2010). If participation in extracurricular activities is expected to predict lower risky substance use, then this relationship should be modeled to include the expected change in an adolescent's problematic drinking and drug use. We take this approach in examining the links between activities and risky substance use over time.

Structured extracurricular contexts are a promising prevention setting for averting heavy alcohol and drug use. Adolescents who engage in structured, adult-supervised activities in their leisure time have fewer opportunities to engage in problem behaviors with their peers (Anderson and Hughes 2009; Miller 2013; Osgood et al. 1996). However, time use alone cannot explain the potential protective effects of activity settings (Mahoney et al. 2001), and, as explained below, different types of extracurricular activities have different influences on youths' development, including risky behavior. In fact, because of their different adolescent outcomes, and also different goals, group norms, and settings, extracurricular contexts are commonly clustered into two types—sports and activities.

Activities and Risk

In general, adolescent participation in activities—including participation in performing arts, service clubs, and academic clubs—predicts an array of positive developmental outcomes, including better grades, self-esteem, civic engagement, and leadership qualities (see Barber et al. 2014 for a review). Participation in these settings also protects adolescents against risky behavior and substance use (Eccles and Barber 1999; Feldman and Matjasko 2005; Mahoney et al. 2005). These protective effects of activities may be the result of constructive peer norms, prosocial experiences, or the structuring of a positive identity, all of which likely contribute to adolescents' successful development (Barber et al. 2014). These activity contexts provide the scaffolding for improved emotional self-management and decision-making, and they may be especially helpful for at-risk youth in this regard (e.g. Williamson et al. 2015). As a result, extracurricular activities are a highly promising prevention setting, especially given that they are already widely implemented (Durlak et al. 2010; Guerra et al. 2014).

Sports and Risk

While participation in activities is linked to lower rates of risk behaviors including dangerous drinking and drug use, some research suggests that participation in sports may increase adolescents' risk for substance use. A growing number of studies have demonstrated that the participation in sports is linked to higher rates of substance use among adolescents (Barber et al. 2001; Fauth et al. 2007; Modecki et al. 2014; Wichstrom and Wichstrom 2008), although findings are somewhat heterogeneous (Perry-Burney and Takyi 2002). One explanation for the role of sports in adolescents' substance use is that fellow athletes and teammates who engage in substance use themselves socialize adolescents towards greater drinking and drug use (Blomfield and Barber 2010; Eccles and Barber 1999). In fact, just as conscientiousness may explain adolescents' participation in activities and reduced binge drinking, lower levels of this personality trait could also explain why some adolescents are more likely to engage in binge drinking as a result of negative norms and risky peers in sport settings. Adolescents who are lower in conscientiousness may be more willing to follow anti-social conventions (Jackson et al. 2010) and may be more susceptible to negative teammate influences (Jensen-Campbell and Malcolm 2007).

Conscientiousness and Risky Behavior

Why might conscientiousness be especially salient to different time-use settings and adolescents' risk taking? Conscientious adolescents tend to follow social norms for impulse control, to be goal-directed, and to be organized (Jackson et al. 2010). As a part of the Big Five model of personality traits, conscientiousness also includes several lower-order facets, such as industriousness and impulse control. Thus, conscientiousness is associated with both productive use of time and also greater capacity to constrain negative behaviors. Not surprisingly, research on conscientiousness shows robust links with positive outcomes (Ozer and Benet-Martínez 2006), including academic achievement (Noftle and Robins 2007; O'Connor and Paunonen 2007), work performance (Hogan and Holland 2003), and health (Bogg and Roberts 2004, 2013).

Conscientiousness also develops and changes across the lifespan. Some studies show that conscientiousness decreases during adolescence (De Fruyt et al. 2006; Pullmann et al. 2006), although other research suggests that it is relatively stable in adolescence (Klimstra et al. 2009; Roberts et al. 2006). However, as adolescents enter emerging adulthood, conscientiousness appears to increase (Lüdtke et al. 2009), and the largest mean-level increases in conscientiousness occur during young adulthood with smaller mean-level increases occurring later in life (Roberts et al. 2006). Such demonstrated change in conscientiousness is important in part because of the "maturity principle" of personality development (Caspi et al. 2005). This principle proposes that over time, personality traits tend to change in ways that predict psychological health and positive life outcomes. In particular, change in conscientiousness is often evidence of successful transition to adulthood, as the transition from high school to college (Bleidorn 2012). For example, conscientiousness development from age 18–26 predicts job satisfaction and work involvement in young adulthood (Roberts et al. 2003). In turn, these work experiences predict changes in conscientiousness in young adulthood. As such, normative change in conscientiousness may reflect the adoption of more adult social roles.

Given the theoretical links between conscientiousness and risk behaviors, Bogg and Roberts (2004) conducted a meta-analysis on the relationship between the two constructs. Conscientiousness had significant negative relationship with risky behavior, including tobacco use, drug use, risky driving, risky sex, suicide, and unhealthy eating. Relevant to the present study, the strongest relationships between conscientiousness and risk included drug use ($r = -.28$) and excessive drinking ($r = -.25$). Not only was the relationship between conscientiousness and risk behavior consistent across multiple types of risk behavior, but the moderate to large effect sizes found in this comprehensive meta-analysis reflect robust relationships in the literature. Longitudinal analyses of conscientiousness and risk behavior also reflect robust associations. In young adulthood, increases in conscientiousness are related to decreases in alcohol problems (Littlefield et al. 2010) and soft drug use (Klimstra et al. 2014).

Childhood ratings of conscientiousness also predict self-reported health later in life (Hampson et al. 2007). One meta-analysis shows that people higher in conscientiousness also live longer ($r = .11$; Kern and Friedman 2008). Because of the strength of relationships between conscientiousness and health, Bogg and Roberts (2013) proposed to measure conscientiousness like other epidemiological variables, such as socioeconomic status, when studying health behaviors.

Importantly, the relationship between conscientiousness and reduced risk behavior is also found among adolescents. For instance, one study of substance use across 4 years of high school found that higher levels of conscientiousness predicted first-time alcohol and tobacco use at a later age (Hagger-Johnson et al. 2013). Moreover, higher levels of conscientiousness predicted less rapid increases in alcohol use over time. Low conscientiousness predicted a higher likelihood of heavy drinking in adolescence (Chassin et al. 2004; Slagt et al. 2015), in both self-reports and parental reports (Loukas et al. 2000). In other studies examining behaviors beyond risky substance use, tobacco use is negatively associated with conscientiousness, and higher rates of conscientiousness strengthen the link between intending not to smoke and actual smoking behavior (Conner et al. 2009; Hagger-Johnson et al. 2013). Conscientiousness also moderates the relationship between perceived peer delinquent behavior and personal delinquent behavior, in which low conscientiousness was related to more peer influence on personal delinquency, and high conscientiousness buffered against peer influence on personal delinquency (Slagt et al. 2015). Thus, conscientiousness may not only reflect a prosocial attribute that directs youth towards positive settings and behaviors; but, it may also reflect a reduced susceptibility to negative socializing influences (Jensen-Campbell and Malcolm 2007; Loukas et al. 2000).

Investigating Activities and Conscientiousness

Both conscientiousness and participation in activities predict positive adolescent development into young adulthood; however, an important unanswered question is whether conscientious adolescents are more likely to take part in activities. This question may be especially relevant for participation in activities that tend to be particularly prosocial (Jackson et al. 2010). Theoretically, there is a compelling rationale that conscientious students are more likely than unconscientious students to self-select into

extracurricular activities, particularly activities that need self-discipline or regular practice, such as band or drama. To gain and to refine the skills required by these activities requires adolescents to venture beyond mere interest in the activity to behave conscientiously. However, the direct relationship between activities and conscientiousness has been neglected in past research.

Some preliminary evidence that points to a possible relationship between adolescent participation in activities and conscientiousness. In a meta-analysis, Lodi-Smith and Roberts (2007) found that conscientiousness in adults was related to social investment across different domains including volunteer activities. Further, in a sample of college students, Rubin et al. (2002) found that conscientiousness was related to higher scores along an index of extracurricular activities, which combined sports and activities together, as well as leadership roles within these activities. This combined evidence suggests that conscientiousness and participation in activities are likely related. As a result, the positive effects of activities on risk taking could simply reflect a selection bias into activities among highly conscientious youth, who are arguably more likely to participate in activity settings and also less likely to engage in risky substance use.

Although the positive links between conscientiousness and activities are apparent, it is less clear how conscientiousness is related to sports. Participation in sports might be related to lower conscientiousness in adolescence, especially as participation in sports does predict increased risky behavior (Modecki et al. 2014). Low conscientiousness is related to participating in risky sports (Tok 2011) and taking more risks in high-risk sports (e.g., parkour or free-running; Merritt and Tharp 2013). However, other elements of sports might be related to higher conscientiousness. Athletes engage in regular conditioning and practice that require them to be organized and goal-directed. In particular, conscientious behavior likely is important for dedicated athletes or elite athletes. There is some support for this idea—a study found that adult athletes have higher conscientiousness than non-athletes (Malinauskas et al. 2014) and more elite athletes have higher levels of conscientiousness than do lower-level athletes (Allen et al. 2011). The combined evidence is unclear whether conscientiousness and participation in sports are related among adolescents or how this trait and context together predict changes in risky substance use during adolescence.

Current Study

In the current study, we examined whether participation in organized activities protects against adolescents' risky substance use, even beyond development in conscientiousness. First, we tested whether conscientious youth are more or less likely to engage in extracurricular activity settings during the final 3 years of high school.

Second, we assessed whether developmental trajectories of conscientiousness were related to developmental trajectories of risky substance use across the 3 years. Third, we determined whether extracurricular activities—both activities and sports—predicted risky substance use concurrently or a year later while controlling for change in substance use and conscientiousness development. We added participation in both sports and activities for each of the 3 years as time-varying covariates, which provided a complete test of the relationships between extracurricular activities, conscientiousness, and risky substance use over time.

Adolescents who are male (Tucker et al. 2003), from a lower SES background (Hampson et al. 2007), and have early pubertal timing (Westling et al. 2008) tend to engage in heightened levels of risky substance use, so we controlled for these variables in our models.

Methods

Participants

The sample comprised 687 Western Australian students (55 % female) who were recruited for the Youth Activity Participation Survey (YAPS; Blomfield and Barber 2011; Modecki et al. 2013). This sample of participants started the survey in Year 10, and it includes data from three waves of annual data collection (Year 10–Year 12). The mean age of participants at Year 10 was 15.37 years ($SD = 0.36$) and ranged from 14 to 16 years. The majority of participants were Caucasian (85.4 %), followed by 8.2 % Asian, 1.1 % Aboriginal or Torres Strait Islander, and 5.5 % other (Middle Eastern, African, Indian, and Maori).

Procedure

The Youth Activity Participation Survey of Western Australia (YAPS-WA) was an eight-year longitudinal study that started in 2007 (Modecki et al. 2013). This particular cohort was measured for 3 years, starting in 2007 when the participants were in Year 10. We surveyed students by visiting 39 schools across Western Australia in both metropolitan and regional school districts. We surveyed both government schools and Catholic/independent schools in each region. We recruited schools by contacting school principals, and maintained regular contact with these schools over the years. We recruited students through assemblies and in-class recruiting strategies. The students

who returned parent consent forms and who completed their own consent forms were allowed to participate. We assessed the students in school by using laptops (and later, tablet computers) that were connected to our portable intranet server. The survey took about 45 min for the students to complete. For the follow-up years, we made arrangements with a school contact and the school principal to assess the students around the same time each year. The annual survey asked youth to reflect on their participation during the school year when reporting on their participation.

For this cohort, we recruited participants in 2007. Some follow-up recruitment of this cohort in 2008 targeted regional and disadvantaged schools, with a total cohort of 831. Participation rates from this total cohort were as follows: Year 10 (n = 640), Year 11 (n = 660), and Year 12 (n = 530). For our current sample (n = 687), we used participants who participated in at least one wave and who had sufficient data for calculations in Mplus (e.g., at least one measure of Conscientiousness in Year 10, 11, or 12).

Measures

Table 1 shows the descriptive statistics and correlations for the measures used in this study.

Participation in Activities

We used a dichotomous variable to test whether participating in activities yielded any predictive effects. We measured participation in activities at all three time points. Participants indicated whether they participated in any activities (e.g., performing arts, service, academic clubs, etc.) in their school or in their community. In each year, participants who took part in activities were coded as "1" while participants who did not take part in any activities were coded as "0." About half the sample in each wave participated in an activity (Year 10 = 54.0 %, Year 11 = 51.2 %, and Year 12 = 47.7 %).

Participation in Sports

We used a dichotomous variable to test whether participating in sports yielded any predictive effects. We measured participation in sports at all three time points. Participants indicated whether they participated in any sports in their school or in their community. In each year, participants who took part in sports were coded as "1" while participants who did not take part in any sports were coded as "0." Participation rates in sports were relatively high across each wave (Year 10 = 74.2 %, Year 11 = 67.1 %, and Year 12 = 66.4 %).

Conscientiousness

Conscientiousness items were derived from the NEO-PI-R (Costa and McCrae 1992). Ten items were taken from three different conscientiousness facets (self-discipline, achievement striving, and dutifulness) to reflect the broad personality construct. Participants responded on a five-point scale from "Strongly Disagree" to "Strongly Agree," and the reliability was good across all three time points (Year 10 $\alpha = .77$, Year 11 $\alpha = .79$, and Year 12 $\alpha = .81$).

Gender

Given gender differences in risky behavior (e.g., Tucker et al. 2003), we included gender as a control variable in our analyses. Gender was self-reported by participants in each wave.

Socioeconomic Status (SES)

Because SES is related to both health behavior and personality traits (Bogg and Roberts 2013; Hampson et al. 2007), it was added as a control variable. SES for all YAPS schools was generated from data attainable through the Australian Curriculum, Assessment and Reporting Authority (ACARA 2008), which computes the Index of Community Socio-Educational Advantage (ICSEA) for each school (see Blomfield and Barber 2011). The ICSEA is calculated by using a wide range of data from the Australian Bureau of Statistics, including the education, occupation, income, ethnicity, and single-parent status of each student's household. The mean ICSEA for this sample was 1023 ($SD = 82$), which is near the average value for Australian schools.

Pubertal Timing

Pubertal timing is related to both risk behavior trajectories (Modecki et al. 2014) and personality development (Markey et al. 2003). We also have used this measure of pubertal timing in previously published studies (Modecki et al. 2014; Modecki et al. 2013). At Year 10 (first time point), we asked participants the following: "Teenagers' bodies change a lot as they grow up, this is referred to as your physical development. Do you think your physical development has started much later, a little later, around the same time, a little earlier or much earlier than other people your age?" (Dubas et al. 1991). Participants answered on a 5-point scale from "Much Later" to "Much Earlier."

Risky Substance Use

Risky substance use was measured with three items adapted from Fredricks and Eccles (2005). These items included

Table 1 Descriptive statistics and correlations

	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Y10 C	3.38	0.56	–													
2. Y11 C	3.38	0.59	.62**	–												
3. Y12 C	3.35	0.63	.59**	.73**	–											
4. Y10 R	1.56	1.10	−.23**	−.12**	−.14**	–										
5. Y11 R	1.87	1.31	−.21**	−.24**	−.21**	.52**	–									
6. Y12 R	2.32	1.55	−.19**	−.23**	−.26**	.53**	.71**	–								
7. Y10 A	–	–	.11**	.05	.10**	−.14**	−.10**	−.09*	–							
8. Y11 A	–	–	.15**	.11**	.15**	−.09*	−.10**	−.15**	.52**	–						
9. Y12 A	–	–	.09*	.10**	.15**	−.09*	−.13**	−.15**	.44**	.51**	–					
10. Y10 S	–	–	.16**	.12**	.10**	.05	.08*	.15**	.00	−.06	−.03	–				
11. Y11 S	–	–	.15**	.12**	.10**	.05	.08*	.18**	.01	.00	.02	.53**	–			
12. Y12 S	–	–	.12**	.07	.07	.02	.08*	.15**	.01	−.03	−.07	.49**	.68**	–		
13. PT	2.94	0.90	−.03	−.01	.02	.10**	.02	.02	.02	.00	.05	−.06	.05	.07	–	
14. Gender	–	–	.02	−.02	−.01	.03	.06	.10**	−.20**	−.18**	−.19**	.09*	.17**	.12**	−.06	–
15. SES	1022	81.5	.01	−.01	−.03	−.07	.08*	.09*	.26**	.20**	.16**	.11**	.02	.01	−.05	.01

$N = 687$. Year 10–Year 12 (Y10–Y12). Conscientiousness (C). Risky substance use (R). Participation in activities (A), Participation in sports (S) in which 0 = No Participation and 1 = Participation. Pubertal timing (PT). Gender in which 0 = females and 1 = males. Socio-economic Status (SES). Omitted means and standard deviations for dichotomous variables

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

measures of binge drinking, getting drunk, and illegal drug use: (1) "About how often in the last 6 months have you had more than 5 alcoholic drinks on one occasion?"; (2) "About how often in the last 6 months have you been drunk?"; and (3) "About how often in the last 6 months have you used illegal drugs?" These items were measured on an eight-point scale from 1 "none" to 8 "31 or more times." At Year 10, risky substance use was correlated with drinking alcohol, $r(607) = .77$, $p < .001$, and having contact with the police, $r(609) = .40$, $p < .001$. At all three time points (Year 10–Year 12), these items had good reliability (Year 10 $\alpha = .84$, Year 11 $\alpha = .82$, and Year 12 $\alpha = .82$).

Analytic Strategy

As an initial test of the relationship between conscientiousness and participation in activities, we ran a series of *t* tests in SPSS for each year to determine whether adolescents who participated in activities were more conscientious than adolescents who did not participate in activities. After this initial test, we tested the central research question of whether conscientiousness and risky substance use develop independently or concomitantly. We used latent growth curve modeling (LGM) in Mplus 7 (Muthén and Muthén 2012). Our analyses used MLR estimation, which is a maximum likelihood estimator with robust standard errors to account for non-normality in the data. To test our primary research question, we first conducted a series of LGM analyses to determine the best fitting unconditional models for change in risky substance use and for change in conscientiousness across the 3 years. The best fitting unconditional model was determined using −2 log-likelihood nested-model tests. Next, we added time-invariant covariates (i.e., control variables of SES, gender, and pubertal timing) to each model. We then ran a parallel process model to determine the association between the development of conscientiousness and risky substance use. Finally, we added participation in activities and sports as time-variant predictors of risky substance use to determine whether participation predicted risky substance use independently of conscientiousness. We tested both concurrent relationships (e.g., Year 10 activities predicting Year 10 risky substance use) and lagged relationships (e.g., Year 10 activities predicting Year 11 risky substance use). These tests showed whether participation in activities had parallel or delayed benefits in its association with risky substance use. For final unconditional and conditional models, fit was assessed based on several indices, and all models had acceptable fit such that SRMR was $\leq$ 08 (Hu and Bentler 1999). In all but one model, the acceptable fit of RMSEA was $\leq .06$; however, this one model had low degrees of freedom, which can impact the RMSEA (Kenny et al. 2015). In general CFI was >.95, with the exception of our final parallel process model with time-varying covariates. The CFI penalizes for every parameter estimated. Thus, the CFI dipped to .87 in this model, though other indicators pointed to good fit.

Results

Relationships Between Participation and Conscientiousness

The relationships between participation and conscientiousness were examined to determine whether conscientious adolescents were more likely to participate in activities or sports. We tested for the differences in conscientiousness between adolescents who participated in activities and those who did not. Table 2 contains *t* tests for each year (Year 10, Year 11, and Year 12). For Years 10 and 12, adolescents who participated in activities had higher levels of conscientiousness than those who did not participate in activities. In Year 11, this difference was marginally significant ($p = .055$), but the trend followed the same pattern as the other years.

We also checked whether conscientiousness was higher for athletes or non-athletes. For Year 10 and Year 11, adolescents who participated in sports had a higher level of conscientiousness than those who did not participate in sports. Taken together, these results show that more conscientious adolescents were more likely to participate in activities and sports. As a result, it is important to test further whether participation in activities and sports is related to risky substance use, even after accounting for trait conscientiousness.

Latent Growth Model of Risky Substance Use and Conscientiousness

The unconditional model indicated that risky substance increased linearly over time (Table 3), and there are random effects in the trajectory of risky substance use. These findings suggest that adolescents steadily increased in their risky substance use over time, but there is unexplained between-person variation in this developmental trajectory. In the conditional model, SES, gender, and pubertal timing were added as predictors of the intercept and slope of risky substance use. The results showed that pubertal timing was the only significant predictor on the model intercept. On average, early pubertal timing was related to higher levels of risky substance use in Year 10. SES and gender were significant predictors of the model slope. Male gender and higher SES were associated with accelerated growth in risk over time.

Table 2 Participation group descriptive statistics and *t* tests of conscientiousness

	Participation in activities (at each wave)						95 % CI	*t*	*df*	*d*
	Non-participants			Participants						
	M	*SD*	*n*	*M*	*SD*	*n*				
Y10 C	3.31	.53	272	3.44	.59	309	−.22, −.03	−2.69**	579	−.22
Y11 C	3.28	.60	248	3.38	.59	259	−.21, .00	−1.92	505	−.17
Y12 C	3.29	.62	245	3.47	.62	228	−.30, −.07	−3.21**	471	−.30
	Participation in sports (at each wave)						95 % CI	*t*	*df*	*d*
	Non-participants			Participants						
	M	*SD*	*n*	*M*	*SD*	*n*				
Y10 C	3.22	.59	154	3.44	.55	427	−.32, −.11	−4.09**	579	−.34
Y11 C	3.22	.63	175	3.38	.58	355	−.27, −.05	−2.86**	528	−.25
Y12 C	3.32	.65	158	3.41	.61	315	−.21, −.03	−1.51	471	−.14

Year 10–Year 12 (Y10–Y12). Conscientiousness (C). Participation was calculated for each wave, which was used to test the Conscientiousness differences at that wave

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

Table 3 Latent growth curve models of risky substance use and conscientiousness

	Unstandardized estimates	Standardized estimates
Risky substance use		
Intercept		
Mean	1.55***	1.91***
Variance	0.33***	–
Slope		
Mean	0.65***	0.75***
Variance	0.19*	–
Model Fit		
CFI	–	
RMSEA	–	
SRMR	–	
Conscientiousness		
Intercept		
Mean	3.36***	7.41***
Variance	0.23***	–
Slope		
Mean	−0.01	−0.06
Variance	0.03**	–
Model fit		
CFI	0.99	
RMSEA	0.07	
SRMR	0.02	

The standardized estimates for variance are omitted as they are all standardized at 1.00. The risky substance use model had the last time point free as the best fitting model in −2 log-likelihood tests, which explains the fit indices for this model

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

For conscientiousness, the unconditional model indicated that, on average, the construct did not undergo significant development over time (Table 3); however, the significant slope variance indicates that that not all adolescents grew in conscientiousness at the same rate and there was significant between-person variability. In the

conditional model, neither SES, nor gender, nor pubertal timing was a significant predictor of the intercept or slope of conscientiousness.

Parallel Process LGM of Risky Substance Use and Conscientiousness

Next, the paired association between risky substance use and conscientiousness trajectories was tested using a parallel process LGM. The model fit was good (Table 4). The significant negative correlation between the intercepts suggested that the initial average level of risky substance use was inversely related to the initial average level of conscientiousness. Higher risky substance use was associated with lower conscientiousness. Moreover, the slopes were also significantly negatively correlated. Increases in risky substance use were associated with parallel declines in conscientiousness. Despite parallel associations, there were no significant intercept-to-slope relationships in this parallel process model. Early conscientiousness was not predicative of change in substance use, nor vice versa.

The relationships between the time invariant covariates and the intercepts and slopes of risky substance use and conscientiousness were consistent with the univariate models. Early pubertal timing was related to higher initial levels of risky substance use (intercept). Male gender and higher SES predicted accelerated growth in risky substance use (slope). None of the covariates predicted the intercept or slope of conscientiousness.

Participation as a Time-Varying Covariate

Our final model tested whether participation in activities and sports yields the expected benefits or risks in their relationship to problematic drinking and drug use, even when controlling for the development of conscientiousness, and adolescents' expected development of substance use. For these models, we used dichotomous variables for

Table 4 Parallel process model of conscientiousness and risk

	Unstandardized estimates	Standardized estimates
Parallel process		
Con intercept predicting risk slope	0.03 (.02)	0.16 (.09)
Risk intercept predicting con slope	−0.07 (.09)	−0.06 (.08)
Con and risk intercept correlation	−0.14*** (.03)	−0.34*** (.09)
Con and risk slope correlation	−0.03*** (.01)	−0.34*** (.11)
Time invariant covariates		
Conscientiousness intercept		
Gender	0.01 (.04)	0.01 (.05)
SES	0.00 (.00)	0.01 (.05)
Pubertal timing	−0.02 (.02)	−0.04 (.04)
Conscientiousness slope		
Gender	−0.02 (.03)	−0.04 (.07)
SES	0.00 (.00)	−0.05 (.07)
Pubertal timing	0.01 (.01)	0.05 (.07)
Risky substance use intercept		
Gender	0.07 (.09)	0.04 (.05)
SES	0.00 (.00)	−0.05 (.05)
Pubertal timing	0.12* (.05)	0.12* (.05)
Risky substance use slope		
Gender	0.12* (.06)	0.11* (.06)
SES	0.00* (.00)	0.18** (.06)
Pubertal timing	−0.04 (.03)	−0.07 (.06)
Model fit		
CFI	0.99	
RMSEA	0.03	
SRMR	0.02	

$N = 687$, Standard errors are in parentheses. Conscientiousness (Con), Risk (risky substance use), socioeconomic status (SES). Gender was coded as 0 = females and 1 = males. SES values range from low SES to high SES. Pubertal timing ranges from 1 = Much Later to 5 = Much Earlier

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

participation (0 = no participation, 1 = participation) measured at all 3 time points. We tested both concurrent relationships and lagged predictors of activities on risky substance use to determine if there were immediate or delayed relationships of participation.

Table 5 shows the results of this model. Once the participation variables were added as time varying covariates, the intercept of risky substance use significantly predicted the slope of conscientiousness. We suspect this relationship is a suppression effect as a result of significant variance in risky substance use being associated with participation in activities and sports.

For the concurrent time-varying predictors, Year 10 participation in activities predicted lower Year 10 risky substance use. However, the concurrent predictors for Year 11 and Year 12 participation in activities did not significantly predict risky substance use at the same grade level. Further, Year 10 participation in sports was associated with significantly greater Year 10 risky substance use, and Year 11 participation in sports had a marginal positive relationship with Year 11 risky substance use. However, the association between concurrent Year 12 participation in sports and risky substance use was non-significant,

For the lagged time-varying predictors, both activity predictors were associated with diminished risky substance use. Year 10 participation in activities predicted lower levels of risky substance use in Year 11, and Year 11 participation in activities predicted lower levels of risky substance use in Year 12. For sports, Year 11 participation in sports predicted higher Year 12 risky substance use. But there were no lagged effects for Year 10 participation in sports on risky substance use in Year 11.

Taken together, these results suggest that the protective benefits of activities do predict less risky substance use 1 year later, even when controlling for the parallel development of conscientiousness and risky substance use, and the concurrent associations between activities and risky substance use. On the other hand, the results for sports were less robust, though there was some indication that participation was related to risky substance use. Out

Table 5 Parallel process model of conscientiousness and risky substance with participation as a time-varying covariate

	Unstandardized estimates	Standardized estimates
Parallel process		
Con intercept predicting risk slope	0.04* (.02)	0.19* (.09)
Risk intercept predicting con slope	−0.12 (.12)	−0.10 (.09)
Con and risk intercept correlation	−0.14*** (.03)	−0.34*** (.06)
Con and risk slope correlation	−0.04*** (.01)	−0.38*** (.10)
Concurrent TVC (activity on risk)		
Y10 participation on Y10 risk	−0.23** (.08)	−0.11** (.04)
Y11 participation on Y11 risk	−0.13 (.09)	−0.05 (.03)
Y12 participation on Y12 risk	−0.09 (.10)	−0.03 (.03)
Lagged TVC (activity on risk)		
Y10 participation On Y11 risk	−0.19* (.08)	−0.07* (.03)
Y11 participation on Y12 risk	−0.34** (.12)	−0.11** (.04)
Concurrent TVC (sports on risk)		
Y10 participation on Y10 risk	0.19* (.09)	0.08* (.03)
Y11 participation on Y11 risk	0.19 (.11)	0.07 (.04)
Y12 participation on Y12 risk	0.08 (.11)	0.02 (.04)
Lagged TVC (sports on risk)		
Y10 participation on Y11 risk	0.06 (.12)	0.02 (.04)
Y11 participation on Y12 risk	0.58*** (.13)	0.18*** (.04)
Model fit		
CFI	0.87	
RMSEA	0.06	
SRMR	0.07	

$N = 687$, Standard Errors are in parentheses. Conscientiousness (Con), Risky Substance Use (Risk), Time-Varying Covariate (TVC), Year 10–Year 12 (Y10–Y12). Concurrent TVCs refer to participation relationships to risky substance use in the same year. Lagged TVCs refer to participation relationships to risky substance use a year later. Both participation in activities and in sports were coded as 0 = No participation, 1 = Participation

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

of five possible paths (concurrent and lagged), two were significant.

Sensitivity Analyses

We tested the robustness of our model via a series of sensitivity analyses. First, we ran alternate models to ensure that our key results of participation in activities and sports were not artifacts of a complex parallel process model. Thus, we tested a model using only participation in activities as a time-varying covariate and a model using only participation in sports as a time-varying covariate. Both models replicated the findings in our overall model. Second, we ran a simpler model with risky substance use as the sole trajectory. In this model, activities and sports were again entered as time-varying covariates. The results were substantively similar to those in our final model. Finally, we re-ran our final model using individual risky alcohol use items rather than our composite variable. Again, the results were similar and pointed to the robustness of our final model.

Discussion

The current study sought to parse the protective effects of conscientiousness and participation in activities on adolescents' risky substance use. Unraveling the positive effects of participation in activities from those of conscientious personality is important because it guides prevention efforts and helps to demonstrate concretely that activity settings are independently protective against adolescent substance use (Eccles and Barber 1999; Feldman and Matjasko 2005; Mahoney et al. 2005; Modecki et al. 2014). By modeling change in conscientiousness, we are able to account for the fact that adolescents who are highly conscientious also tend to participate in non-sport activities. Notably, our findings show that conscientiousness development and participation in activities were independently associated with risky substance use. Further and consistent with prior research, early conscientiousness and risky substance use and their subsequent change were strongly related (Hagger-Johnson et al. 2013). However, participation in activities still was linked with diminished levels of risky substance use 1 year later, even after accounting for change in conscientiousness and change in risky substance use, along with their linked associations. Athletes did report higher conscientiousness than non-athletes; however, participation in sports was still associated with greater risky substance use at several time-points. Ultimately, hard-working and self-disciplined adolescents may self-select into extracurricular activities (both activities and sports), but conscientiousness and extracurricular settings both have distinct relationships to adolescent risk behavior.

The protective benefits of activities are clearly rooted in specific, structured contexts not explained by conscientiousness alone. Such benefits include adult mentorship and leadership development, which aid adolescents through prosocial development and protection against risk (Barber et al. 2014). Activity settings also provide a context for shared creation of prosocial group norms and identities, both of which help to facilitate positive development and diminish problem behavior involvement (Mahoney et al. 2005). By providing an adult-led, structured environment in which youth can create positive friendships and constructive views of themselves and their social roles, activities appear to reduce the allure of risky substance use (Miller 2013; Osgood et al. 1996). Our results suggest that there is not necessarily an immediate, concurrent relationship between participation in activities and lower risky substance use. Rather, the lagged relationships imply that there is a delayed influence in which activities may protect youth against subsequent risky behavior. Importantly, these time-specific effects were tested above and beyond adolescents' expected trajectory of risky substance use. Thus, our findings indicate that, 1 year after engaging in activities, youths' risk for substance use is decreased below what would be their expected level (e.g., Chassin et al. 2010).

Conversely, our findings show that participation in sports was related to higher risky substance use, consistent with prior research (Barber et al. 2001; Fauth et al. 2007; Wichstrom and Wichstrom 2008). This pattern of risk was not as clear as was the pattern of protection for activities. That is, participation in sports predicted concurrent risk in some cases (Year 10 and marginal for Year 11) and delayed risk in another case (Year 11 sports predicting Year 12 risk). These results highlight a possibly more complex relationship between risk and sports that was not explored here. For example, taking into account the sports season or the type of sport (e.g., individual or team sports) might explain this relationship further (Lorente et al. 2004). As another example, the peers involved in some sports may catalyze risks more than the peers in other sports. Further, the unique contextual factors of sports may predict this relationship with risk. These factors include a culture of drinking around certain sports events, as well as hanging around peers and teammates who are also more likely to drink (Blomfield and Barber 2010; Eccles and Barber 1999).

In line with past research on adults, conscientiousness was associated with lower initial risk and slower increases in risk behavior, in this case substance use (Bogg and Roberts 2004). Although our findings suggest stability in conscientiousness across the last 3 years of high school, conscientiousness still had a protective effect on risky substance use. That is, early personality and substance use

were correlated, as were change in personality and substance use. Further, once the time-varying effects of participation were accounted for, early high levels of conscientiousness predicted slower increases in risky substance use across time. Altogether, beyond conscientiousness, which may or may not be changeable through intervention (Klimstra et al. 2009), activities are arguably another means to deflect adolescents from the possible development of risky substance use, via structured, prosocial, adult-led contexts.

As discussed above, peers—whether risky or prosocial—likely facilitate risk or protect against risk within these extracurricular settings. Thus, one extension of this research would be to investigate the influence of peers as a potential moderator of the relationships between conscientiousness, participation in activities, and risk (Blomfield and Barber 2011). Peer information would be an important additional context to interpret our results (e.g. Monahan et al. 2014; McDonough et al. 2015; Rebellon and Modecki 2014). In fact, recent research found that perceptions of peer delinquency and personal delinquency are moderated by conscientiousness (Slagt et al. 2015). Conscientious adolescents may self-select into activities and into a prosocial peer group that provide better protection against risk. The combination of personality and context, such as activities or peers, is essential to understanding the interrelated factors that affect adolescent risk taking (Modecki 2009; Park et al. 2009).

While there were several strengths to this study, this work is not without its limitations. Our sample of Western Australian students may not be generalizable to other countries. As indicated in the introduction, there are many similarities between rates of substance use in Australia and the rest of the world, but these specific relationships between participation in activities and conscientiousness may differ in other countries. Also, this study relied on adolescent self-report. Adolescents might not be willing to disclose their risky substance use on a survey, although we were clear with our participants about the confidentiality of their data. Moreover, parental reports could be helpful as an individual measure of SES. Parents also may play a role in whether or not adolescents engage in activities and sports; this would be an important factor to consider in this process (e.g. Dawes et al. 2015).

Conclusion

This study's findings demonstrate that adolescents' participation in activities is associated with lower risky substance use, and this relationship does not reflect a confound with adolescents' conscientiousness. Rather, the results suggest that participation in activities, even when accounting for personality change, protect against subsequent risk. While we cannot determine the true cause of these benefits of activities, our lagged design suggests that participation in activities is related to lower risky substance use measured a year later. More research is needed to explore which specific structured activities or which aspects of these activities facilitate reductions in risky substance use. It is not yet clear what "active ingredients" enable program change within structured activity settings (Feldman and Matjasko 2007; Williamson et al. 2015). Given the fairly robust positive effects of activities shown in this study and others (see Barber et al. 2014 for a review), this question is worthy of future attention. Our findings make clear that it is not merely the diligent and hard-working adolescents who receive prosocial benefit from extracurricular activities. The benefits of participating in activities on reducing substance use could arguably extend to other adolescents as well.

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Authors' Contributions K.O.M. conceived of the study, participated in the coordination of the study, performed the statistical analyses, and drafted the manuscript. K.L.M. also participated in the conception of the study, consulted on data analysis and interpretation of results, and helped to draft the manuscript. B.B. conceived of the longitudinal project, participated in the design of the study, interpretation of the data, and writing of the manuscript. All authors read and approved the final manuscript.

Conflicts of interest The authors report no conflicts of interest.

Ethical Standards All YAPS-WA personnel acted in compliance with the approved ethical standards and procedures.

Ethical Approval This study was approved by the Murdoch University Human Research Ethics Committee and Griffith University Human Research Ethics Committee. This research was also approved by the Western Australian Department of Education and the Catholic Education Office to conduct research at the schools.

Informed Consent We received informed consent from both the parents and the students prior to participation.

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