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Predicting Risk-Taking With and Without Substance Use: The Effects of Parental Monitoring, School Bonding, and Sports Participation

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Abstract

Risk-taking is statistically normative during adolescence, yet is associated with adverse outcomes including substance use. The present study draws the distinction between protective factors (effective for those identified as high risk takers) and promotive factors (effective for all) against substance use, focusing on parental monitoring, school bonding, and sports participation. A total of 36,514 8th and 10th grade participants in the national Monitoring the Future study were included. Although parental monitoring was associated with lower alcohol and marijuana use among all adolescents (i.e., promotive effect), these effects were strongest among the highest risk takers (i.e., protective effect) and females. School bonding was associated with lower levels of both alcohol and marijuana use among all groups of adolescents, but these promotive effects were weak. Sports participation was associated with higher levels of alcohol use among all males and among 8th grade females who did not identify as high risk takers. Despite being a risk factor for alcohol use, sports participation did demonstrate a promotive effect against marijuana use among 10th grade females only, and especially so for high risk-taking females (i.e., protective effect). Overall, these findings suggest that of the three mechanisms studied, parental monitoring emerged as the most promising entry point for substance use prevention and intervention across groups, particularly for females and high risk-taking adolescents.

Keywords

risk-taking; substance use; sports; parental monitoring; school bonding

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During adolescence, risk-taking is considered to be common, and even normative (Arnett, 1992; Zoccolillo, Vitaro, & Tremblay, 1999). Risk-taking has been defined as making choices or participating in activities that could have negative consequences; to take a risk, there must not be a guarantee of a positive or neutral outcome (Boyer, 2006). Although this definition is exceptionally broad, the potential for a detrimental outcome is the salient factor that distinguishes whether or not someone is taking a risk. Risk-taking is closely linked with

sensation-seeking and has been included in the definition of sensation-seeking: “the need of experiences and complex, new, varied sensations, and *the wish to take physical and social risks* through each experience” (Zuckerman, 1979, p.10, emphasis added). Individual differences in the intensity of sensation sought have been proposed to explain individual differences in risk-taking behaviors. The more novel and stimulating experiences one needs to be satisfied, the more likely he/she is to engage in dangerous risk-taking behaviors (Rolison & Scherman, 2002).

It is not surprising that sensation-seeking in general, and the tendency for risk-taking more specifically, are linked with participation in a variety of reckless behaviors including risky sex (Zuckerman, 2007), drunk driving (Arnett, 1990), and substance use - the outcome of interest in the current study (Crawford, Pentz, Chou, Li, & Dwyer, 2003; Pilgrim, Schulenberg, O'Malley, Bachman, & Johnston, 2006; Schulenberg et al., 2005). In previous research on sensation-seeking and substance use, approximately 80% of adolescent substance users were identified as being high in sensation-seeking (Donohew, Helm, Lawrence, & Shatzner, 1990). Hansen and Breivik (2001) provided evidence linking sensation-seeking with the use of multiple drugs and criminality among adolescents and young adults. Martin et al. (2002) provided evidence that those higher in sensation-seeking begin using substances earlier and that sensation-seeking mediated the relationship between pubertal status and substance use.

From a developmental psychopathology perspective, a characteristic or environmental condition that increases the statistical odds for developmental difficulties is termed a *risk factor* (Garmezy, 1991). Based on the reviewed literature, we can conclude that a tendency toward risk-taking is a risk factor for substance use in adolescence. Therefore, those who identify as high in risk-taking are considered at-risk adolescents in the present study. Our primary focus here is on adolescents who are at-risk for substance use because of their high level of risk-taking, yet successfully avoid high levels of substance use.

Despite the potentially devastating consequences of some risk-taking behaviors, risk-taking can be functional, especially during adolescence. In fact, biological changes during adolescence likely *encourage* increased sensation-seeking and risk-taking behavior, particularly changes in brain development that are linked with novelty-seeking (Spear, 2000; Steinberg, 2008). These changes serve an important function, as critical developmental tasks such as self-discovery and independence involve an inherent degree of risk-taking (Maggs & Schulenberg, 2005; Spear, 2007). For example, adolescents are faced with the tasks of separating from their parents, exploring their capabilities in order to define their identities (e.g., Cote, 2009; Erikson, 1970; Marcia, 1980), and refining their decision-making skills in the face of strong emotion (Reyna & Farley, 2006; Steinberg, 2008). Together, these changes and tasks of adolescence support the contention that an elevated level of risk-taking is normative and likely functional.

In addition to the potential functionality of risk-taking, it is important to recognize the distinction between reckless risk-taking and more adaptive risk-taking. As previously discussed, risk-taking by definition is a broad construct based upon an uncertain, but potentially negative, outcome; therefore, it can include both developmentally appropriate and inappropriate activities. Although reckless risk-taking behaviors account for the bulk of the outcomes measured in the literature, Hansen and Breivik (2001) found that more adolescents engage in what they term “positive” risk-taking, such as bicycling quickly or riding rollercoasters, than engage in reckless risk-taking. Schroth and McCormack (2000) also challenged clinical conceptualizations of risk-taking in their study of students who studied abroad, suggesting a link between sensation-seeking and studying abroad to experience new academic and cultural contexts.

Variables that mitigate the negative effects of a risk factor are *protective factors* (Gutman, Sameroff, & Cole, 2003; Jessor, Van den Bos, Vanderryn, Costa, & Turbin, 1995). Protective factors have a larger beneficial influence for those who are considered to be at-risk for a detrimental outcome; in other words, protective factors are evidenced as interactions with risk level in predicting outcomes. Factors associated with better outcomes among all individuals, *regardless of risk*, are known as *promotive factors* (Gutman et al., 2003; Sameroff, 2000). The same variable can exhibit both promotive and protective effects when associated with positive outcomes across all levels of risk, yet demonstrating a greater impact for those at higher risk.

To place the understanding of substance use etiology within a broader developmental model (Chassin, Hussong, & Beltran, 2009; Hawkins, Catalano, & Miller, 1992; Maggs & Schulenberg, 2005), we consider three constructs that have the potential to serve as buffers against substance use: parental monitoring, school bonding, and sports participation. These three factors are likely to be correlated; therefore, the simultaneous study of their potential protective and promotive effects allowed us to examine the unique contributions of each. Parental monitoring has been proposed as a method of intervention for youth antisocial behavior (Fallu, et al., 2010). When parental monitoring is high, substance use is typically low (Brown, Mounts, Lamborn, & Steinberg, 1993; Dishion & McMahon, 1998; Pilgrim et al., 2006; Siebenbruner, Englund, Egeland, & Hudson, 2006).

School bonding is also associated with delay of substance use onset and lower average levels of substance use (Hawkins et al., 1997; Henry, Stanley, Edwards, Harkabus, & Chapin, 2009; O'Donnell, Hawkins, & Abbott, 1995). In fact, an experimental program to encourage school bonding has shown some success in decreasing substance use among adolescents (Eggert, Thompson, Herting, Nicholas, & Dicker, 1994). However, school bonding has not been a powerful predictor of substance use in all cases (Bailey & Hubbard, 1990; Bryant, Schulenberg, Bachman, O'Malley, & Johnston, 2000), with some research suggesting that school bonding may become more critical in high school as opposed to earlier grades (see Maddox & Prinz, 2003).

Among adaptive forms of risk-taking, sports participation has received the most attention. In general, athletes report themselves as being higher in sensation-seeking and risk-taking than non-athletes (Schroth, 1995). In addition, those who participate in sports with higher risk for injury or death (e.g., parasailing) are higher in sensation-seeking and risk-taking than athletes in less dangerous sports (e.g., tennis; Chirivella & Martinez, 1994; Franques et al., 2003; Jack & Ronan, 1998; Schroth, 1995). In fact, those who participate in high-risk sports have sensation-seeking profiles similar to those who have substance use disorders (Franques et al., 2003). This provides evidence for the importance of a match between the individual's risk-taking needs and beneficial opportunities in the context of a sport or similar venue (Reyna & Farley, 2006).

Although athletics can provide an appropriate, structured outlet for adolescent risk-taking (Fredricks & Eccles, 2006), risk takers may be drawn to both sports *and* substance use. Several researchers have linked sports participation to increased alcohol use (Darling, Caldwell, & Smith, 2005; Eccles & Barber, 1999), although these findings are not consistent (e.g., Fredricks & Eccles, 2006). In an effort to sort through the inconsistent findings regarding sports and substance use, Moore and Werch (2005) looked for relationships between specific substances and particular sports. Their findings were difficult to interpret, with no distinguishable characteristic linking the sports that were associated with increased alcohol use (e.g., surfing, tennis, basketball) or increased smoking (e.g., skateboarding, wrestling).

The Present Study

The present study addresses important gaps in past research by drawing from large, nationally-representative multi-cohort samples of 8th and 10th students, providing the advantages of representative data and substantial numbers of both males and females with a high propensity for risk-taking. Studies of high risk takers are often limited to males (Arnett, 1990; Slinger & Rudestam, 1997), who are more likely than females to identify as risk takers (Schroth, 1995). An important advantage of this study is the inclusion of high risk-taking females, a proportionally small but important subgroup, as well as comparison groups of males and of females not in the high risk-taking category.

More specifically, we examine whether participation in sports provides a unique protective effect for high risk-taking adolescents. In past research, the inclusion of athletes who fall across a full range of risk-taking proclivities may have muddled any protective effect of sports involvement. That is, sports involvement may be especially protective among high risk takers, given their stronger desire for extreme experiences; failure to consider the moderating effect of risk-taking may have masked important subgroup findings. Furthermore, in contrast to other studies on sports effects, we include parental monitoring and school bonding with sports participation in a larger model to predict alcohol and marijuana use. The inclusion of these two additional potentially promotive and protective factors provides a more complete picture of the protective processes operating among adolescents who are high in risk-taking.

In summary, based on the reviewed literature, we expected that within multivariate models parental monitoring and school bonding would be linked with lower levels of alcohol and marijuana use for all adolescents, thus indicating promotive effects; however, we did not expect sports participation to have a promotive effect across all risk-taking levels. In addition, we expected that the effects of parental monitoring and school bonding would be stronger for high risk takers who might benefit even more from these forms of involvement (i.e., a protective effect); likewise, we expected a protective effect for sports for higher risk takers.

Method

Cross-sectional data from eight sequential cohorts of adolescents (1999–2006) from the Monitoring the Future (MTF) study (Bachman, et al., 2008; Johnston, O'Malley, Bachman, & Schulenberg, 2011) were used. MTF has surveyed nationally-representative samples of 8th and 10th grade students since 1991. Our sample begins with the 1999 cohort as that is the first year that the parental monitoring variables were included. Also, variables of interest were included in only one of multiple questionnaire forms distributed randomly, limiting our sample size to about 2500 per cohort per grade (out of approximately 17,000 per cohort per grade). In addition, only those who answered the questions on gender and risk-taking were included (approximately 4% excluded as missing). Detailed descriptions of the MTF study design and procedure are available in other publications (Bachman et al., 2008; Johnston et al., 2011).

Sample

The total sample for the present study included 36,514 students --18,200 (50%) 8th and 18,314 (50%) 10th graders. Response rates ranged from 85–91%; non-response was almost entirely due to absenteeism. Overall, 59% of respondents were Caucasian, 15% African American, 12% Hispanic, 4% Asian, and 10% were of other or mixed racial or ethnic backgrounds. Approximately 51% of the participants were female.

Measures

Means and standard deviations of all study variables are presented in Table 1.

Risk-taking—Risk-taking tendency was measured with two items ("I like to test myself every now and then by doing something a little risky" and "I get a real kick out of doing things that are a little dangerous"), each rated on a scale from 1 (Disagree) to 5 (Agree). The two items were summed to create a total risk-taking score (Pilgrim et al., 2006; Schulenberg et al., 2005), which formed the basis of categorizing adolescents as high or low/average in risk-taking (grade 8 $\alpha = 0.77$, grade 10 $\alpha = 0.79$). Scores between 2 and 9 were categorized as low/average risk takers, and those who scored the maximum of 10 were categorized as high risk takers. Overall, 15% of 8th grade males, 8% of 8th grade females, 13% of 10th grade males, and 7% of 10th grade females were in the category of high risk takers.

Creating a dichotomy to compare the highest scorers on risk-taking with everyone else was based on theoretical considerations and preliminary analyses. To be certain that we were not missing important relationships by categorizing all those who scored lower than 10 in one single group in these national samples, exploratory multi-group analyses with three groups (2–5: low, 6–9: moderate, 10: high) of risk takers were conducted. At both grade levels, these analyses indicated little or no difference between low and moderate risk takers, whereas both differed from the high risk takers. This supported our contention that high risk takers are distinct from other youth, and groups were formed accordingly. Also, from a theoretical standpoint, we were most interested in the highest risk takers as a distinct group, and the size of our sample and these preliminary analyses permitted comparisons between this group and all other adolescents.

Parental Monitoring—Parental monitoring was measured with three items that asked each adolescent how often his/her parents knew where he/she was after school and when out at night and with whom he/she was when out at night. Each item was rated on a scale from 1 (Never) to 5 (Always). Reliability was adequate (grade 8 $\alpha = 0.86$, grade 10 $\alpha = 0.85$).

School Bonding—School bonding was measured with three items that addressed the adolescent's positive attitudes about school (e.g., "How often did you enjoy being in school?") (Bryant et al., 2000). Items were rated on a scale from 1 (Never) to 5 (Almost always). Reliability was adequate (grades 8 and 10 $\alpha = 0.76$).

Sports—Sports participation was measured with one item that asked about the adolescent's extent of participation in school-based athletic teams during the current school year, on a scale from 1 (Not at all) to 5 (Great).

Alcohol and Marijuana Use—Alcohol and marijuana use were each measured with one item about the frequency of use in the past 30 days on a scale from 1 (0 occasions) to 7 (40+ occasions). The MTF alcohol and drug use measures have been shown to have acceptable psychometric properties (O'Malley, Bachman, & Johnston, 1983).

Data Analysis Plan

All respondents with valid data for gender and risk-taking were included; missing data on other study variables, ranging from 1% to 14% missing, were addressed at the level of the covariance matrix. Structural Equation Modeling (SEM) was used to test the research questions. All SEM analyses were conducted with EQS 6.1 (Bentler, 2004) with maximum likelihood estimation, using an Expectation Maximization (EM) algorithm to deal with missing data. The EM algorithm estimates the covariance matrix following an iterative process of expectation and maximization steps based upon both the input sample statistics

and the estimated contributions of missing data. Sampling weights were included in analyses to adjust for differential selection probabilities at each stage of the MTF sample selection (Johnston et al., 2011).

Modeling of latent factors was of interest even for single indicators, but simply estimating a latent variable as measured without error is generally not justified and yields an under-estimation of true score effects; therefore, residual variances of single-item indicators (sports participation, alcohol use, and marijuana use) were fixed equal to 10% of the total variance for that item based on previous analyses and conservative estimations of error variance (Schulenberg, Bachman, O'Malley, & Johnston, 1994). Sensitivity analyses that varied the percent error variance confirmed the appropriateness of 10% error variance rate.

Multi-group models were analyzed to test for moderation of the effects of parental monitoring, school bonding, and sports on substance use, separately by grade, for four risk by gender groups: high risk-taking males, low/average risk-taking males, high risk-taking females, and low/average risk-taking females. Beginning with a model constraining all factor loadings, factor variances, factor covariances, and structural paths to be equal across the four groups, constraints were released in a stepwise fashion; improvement in the χ^2 statistic was used as a measure of improvement in model fit. In all analyses, constraints were released for all four risk by gender groups simultaneously, and factor loadings remained constrained equal in all models across all groups in order to ensure measurement invariance. To control for potential socio-demographic confounds, final models included race/ethnicity, religiosity, parent education, and cohort as exogenous covariates predicting to the substance use measure, all of which relate to substance use (Bachman, O'Malley, Johnston, Schulenberg & Wallace, 2011; Johnston et al., 2011) and serve to structure the lives of young people (e.g., Conger, Conger, & Martin, 2010; Crosnoe, 2011); all exogenous variables were allowed to covary. Inclusion of these covariates did not change the direction or the statistical significance of any relationships.

Several indices of fit are presented. The chi-square goodness of fit statistic is presented; however, the large sample size limits any meaningful interpretation of this statistic (e.g., Jöreskog & Sörbom, 1989). The Comparative Fit Index (CFI), Standardized Root Mean-Square Residual (SRMR), and the Root Mean-Square Error of Approximation (RMSEA) are the indices of model fit used in this study. A CFI value above 0.95, a SRMR value below 0.08, and a RMSEA value below 0.06 were taken to indicate an acceptable model fit (Hu & Bentler, 1999).

Results

The initial set of multi-group models constrained all factor loadings, factor variances and covariances, and structural paths to be equal across groups. Next, the effect of releasing factor variances was tested, which led to significant improvement in fit for all models. Then, the effect of releasing the exogenous factor covariances was tested, which did not lead to significant improvement in any model; therefore, the covariances of exogenous factors were constrained to be equal for all models. (Note: Figures 1–4 show small differences in covariances due to standardization). Finally, the effect of releasing the paths from the covariates to the substance use outcome was tested. In the 8th grade, this led to significant improvement; in the 10th grade, the improvement was not significant so these constraints were upheld. There were three additional tests, the findings of which are described below: the effect of releasing the path from parental monitoring to substance use; the effect of releasing the path from school bonding to substance use; and the effect of releasing the path from sports participation to substance use.

Alcohol Use, Grade 8

Starting with a fully-constrained model and systematically releasing constraints (see Table 2), the final model allowed factor variances, effects of covariates on the outcome, and structural paths from parental monitoring, school bonding, and sports participation to alcohol use to vary across the four groups. Factor loadings of individual variables and covariances of the predictors were constrained to be equal across all groups; therefore, only the measurement model remained constrained in the final model. This produced a reasonably well-fitting model; CFI = 1.00, SRMR = .04, RMSEA = .04. Standardized coefficients for each group are presented in Figure 1 (in Figures 1 through 4, the measurement model and covariates have been excluded for readability). Parental monitoring was a negative predictor of alcohol use for all groups suggesting a promotive effect; pairwise tests of the beta coefficients revealed that this relationship was stronger for high risk takers indicating an additional protective effect. In general, school bonding was not related to alcohol use; a significant negative relationship existed for average/low risk-taking males only. Sports participation was a positive predictor of alcohol use (i.e., risk factor) for males and for average/low risk-taking females, but did not predict significantly for high risk-taking females.

Alcohol Use, Grade 10

Beginning with a fully-constrained model and systematically releasing constraints (see Table 2), the final model allowed factor variances and structural paths from parental monitoring, school bonding, and sports participation to alcohol use to vary across the four groups. Factor loadings of individual variables, covariances of the predictors, and effects of the covariates on the outcome were constrained to be equal across all groups. This produced a reasonably well-fitting model, with only the SRMR out of acceptable range; CFI = .99, SRMR = .10, RMSEA = .03. Standardized coefficients for each group are presented in Figure 2. Parental monitoring was a negative predictor of alcohol use for all groups, indicating a promotive effect; this relationship was strongest for high risk-taking females indicating an additional protective effect. School bonding was negatively related to alcohol use for females and low/average risk-taking males; again, this relationship was strongest among high risk-taking females indicating a protective effect. Sports participation was a positive predictor of alcohol use for males; a test of the coefficients revealed that this effect was stronger among high risk-taking males. However, sports participation was not a predictor of alcohol use among females.

Marijuana Use, Grade 8

Starting with a fully-constrained model and systematically releasing constraints (see Table 2), the final model allowed factor variances, effects of covariates on the outcome, and structural paths from sports participation, parental monitoring, and school bonding to marijuana use to vary across the four groups. Factor loadings of individual variables and covariances of the predictors were constrained to be equal across all groups. This produced a reasonably well-fitting model; CFI = 1.00, SRMR = .04, RMSEA = .04. Standardized coefficients for each group are presented in Figure 3. Parental monitoring was a negative predictor of marijuana use for high risk-taking males and both risk groups for females, thereby demonstrating a protective effect for males and a promotive effect among females. School bonding emerged as a negative predictor (i.e., promotive effect) of marijuana use for males only. Overall, sports participation was not a significant predictor of marijuana use across all groups.

Marijuana Use, Grade 10

Beginning with a fully-constrained model and systematically releasing constraints (see Table 2), the final model allowed factor variances and structural paths from parental monitoring, school bonding, and sports participation to marijuana use to vary across the four groups. Factor loadings of individual variables, covariances of the predictors, and effects of the covariates on the outcome were constrained to be equal across all groups. This produced a reasonably well-fitting model, with only the SRMR out of acceptable range; CFI = .99, SRMR = .10, RMSEA = .03. Standardized coefficients for each group are presented in Figure 4. Parental monitoring was a negative predictor of marijuana use for females and low/average risk-taking males, and this relationship was strongest for high risk-taking females, indicating both promotive and protective effects among females only. School bonding was negatively related to marijuana use for females (again, this relationship was strongest for high risk-taking females suggesting both promotive and protective effects for females) and for low risk males. Overall, sports participation emerged as a negative predictor of marijuana use for females, with this effect being stronger among high risk-taking females according to a test of coefficients, indicating both promotive and protective effects for females.

Discussion

The current study examined the extent to which parental monitoring, school bonding, and sports participation protected against alcohol and marijuana use among adolescents who identified as high risk takers. We were also interested in promotive effects of these three variables for all adolescents, regardless of risk-taking level. Previous studies have identified parental monitoring (e.g., Dishion & McMahon, 1998) and school bonding (e.g., Hawkins et al., 1997) as predictive of lower levels of substance use; findings on the relationship between sports participation and substance use have been inconsistent (e.g., Moore & Werch, 2005).

In general, regardless of grade, gender, and risk-taking level, parental monitoring had the greatest impact on alcohol and marijuana use; specifically, parental monitoring emerged as a strong promotive factor for lower substance use. This finding supports previous research, which indicates that when parents consistently monitor their adolescents, substance use levels are typically lower (Brown et al., 1993; Siebenbruner et al., 2006). In addition to this main effect, gender and risk-taking level served as moderators. We found that parental monitoring had the strongest effect on both alcohol and marijuana use among high risk takers, indicating that parental monitoring also operates as a protective factor. This effect was particularly strong among females in the 10th grade, suggestive of developmental and gender-specific effects. Although it appears that parental monitoring becomes a more powerful protective factor between 8th and 10th grade for high risk-taking females, the opposite seems to be true for high risk-taking males. This suggests that the effectiveness of parental monitoring varies by gender for high risk-taking adolescents, occurring earlier for males and later for females.

School bonding also emerged as a negative predictor of substance use among females at grade 10; this effect was particularly strong for high risk-taking females. These findings suggest a weak promotive effect of school bonding for females in middle adolescence, with a stronger protective effect among females who are at-risk for substance use difficulties. Previous research has identified weak, inconsistent relationships between school bonding and lower substance use (Bryant et al., 2000; Eggert et al., 1994). The present study provides support for the claim that school bonding is more critical for the adaptive functioning of high school students than for middle school students (Maddox & Prinz,

2003). The current study also suggests that the effect of school bonding on substance use may be moderated by gender and risk-taking level.

Finally, contrary to the hypothesis that sports participation might serve a protective role for high risk-taking adolescents, after accounting for the effects of parental monitoring and school bonding, sports participation was positively associated with alcohol use at grades 8 and 10 for all males and for low risk-taking females; thus, sports participation served as a risk factor for alcohol use. At grade 8, sports participation had no relationship with marijuana use; sports participation negatively predicted marijuana use for 10th grade females only. This effect was particularly strong among those who identified themselves as high risk takers. Taken together, these effects suggest a developmental change between grades 8 and 10 such that sports participation gains a promotive effect against marijuana use for females, as well as a protective effect against marijuana use among high risk-taking females.

These findings are similar to those of Hoffman (2006), who found that sports participation predicted higher levels of alcohol use and lower levels of marijuana use. However, these relationships are weak, suggesting that sports participation may not provide an effective means of intervention to decrease marijuana use. Overall, the findings for sports are most supportive of those of past researchers who found that sports participation may be iatrogenic in its link to increased alcohol use among adolescents, particularly males (Darling et al., 2005; Eccles & Barber, 1999). One hypothesis is that adolescents who enjoy taking risks self-select into sports, and thereby join a peer network where others also enjoy risks, including substance use and other problematic activities (Poulin, Kiesner, Pedersen, & Dishion, 2011). Future research should consider the mechanisms for this link, such as perceptions of peer drinking, the influence of group vs. individual competition sports (e.g., Mays et al., 2010), and how these mechanisms might be moderated by gender, risk-taking, and development.

Strengths and Limitations

The present study was limited to cross-sectional data at two different grade levels. Although cross-sectional studies can provide useful information about potential developmental trends, longitudinal research is necessary to determine whether the current findings reflect age-related change over time rather than cohort or period effects. Future studies should consider both longitudinal changes in the relationships of the constructs over time as well as potential for the meanings of the constructs to change with development (Schulenberg & Maggs, 2002). In addition, the correlational design prevents any firm conclusions about causation. For example, it is not possible to state whether sports participation leads to higher levels of alcohol use (particularly among males), whether alcohol use encourages involvement in sports, or if both sports participation and drinking are caused by other factors such as self-selection mechanisms.

In the present study, those adolescents reporting the highest levels of risk-taking were compared to everyone else, due to both empirical and theoretical decisions based on the present sample and interest in capturing those at the highest levels of risk. Although our choice was informed both by our hypotheses and preliminary empirical evidence, we acknowledge that information may be lost when dichotomizing a continuous variable in this way. Future studies should consider if and how the results differ when risk-taking is used as a continuous variable or when other cut-points are implemented to define risk-taking groups. Furthermore, the present study was limited in the measures available because the data were drawn from a larger, epidemiologic study of substance use among adolescents and young adults. As such, the constructs are constrained to the available items from limited but psychometrically acceptable scales; the trade-offs between the advantages of large representative samples and limitations of available measures are common in secondary

analyses (Duncan, 1991). Further research with multifaceted measures should be conducted to replicate and extend these findings. In addition, our models yielded relatively low levels of variance accounted for in substance use, suggesting the importance of more complex models when seeking fuller explanations for substance use.

Although parental monitoring emerged as the strongest promotive and protective factor against substance use, the mechanisms underlying this relationship cannot be determined in the present study. Recent research has begun to separate the effects of parental control, parental solicitation, and youth disclosure when thinking about how parents become aware of their children's whereabouts and activities (Kerr & Stattin, 2000; Kiesner, Dishion, Poulin, & Pastore, 2009; Stattin & Kerr, 2010). Future studies should consider the multifaceted nature of parental monitoring in order to determine whether the gender and developmental differences in the effect of monitoring on substance use in the present study can be explained by differences in the mechanisms by which parental monitoring operates.

Despite these limitations, the present study contributes to the literature by presenting specific pathways through which some high risk-taking adolescents may be able to avoid, or at least limit, substance use. A strength of this study was the ability to consider the use of multiple substances among various groups of adolescents in order to detect important interactions. By utilizing large, nationally-representative samples of adolescents including proportionally smaller groups such as high risk-taking females, this study provided evidence that parental monitoring and school bonding can serve both promotive and protective roles in the etiologic processes of substance use. Often, the "off-diagonal" subgroups are of greatest interest to prevention researchers – the subgroups high on risk but low on problem behaviors; although proportionally small, research on these groups is nonetheless essential for advancing our understanding of the mechanisms of naturally occurring resilience (Schulenberg & Maggs, 2002).

Practical Implications

Parental monitoring had the strongest promotive effect against substance use for all students, but especially among high risk-taking students. The strongest implication of this study for those in the business of prevention science would be the potential impact of increasing parental monitoring to decrease and prevent substance use, particularly among high risk-taking adolescents and females. Second, interventions and research on their effectiveness could determine whether encouragement of school bonding decreases substance use, particularly among at-risk groups. However, sports participation appears to be a double-edged sword at best, linked with higher levels of alcohol use among males and lower levels of marijuana use only among older adolescent females. Therefore, the present study suggests that sports participation is more likely to be a risk factor for substance use, particularly for males. Prevention and intervention efforts specifically among athletes might be warranted to mitigate the relationship between sports participation and alcohol use. Although data are limited, Pandina and colleagues (2005) recommend programs designed for athletes rather than relying on universally-delivered educational interventions; our findings support this suggestion. Furthermore, as parental monitoring served a protective role against substance use for the high risk takers in the present study, future studies should continue to explore whether monitoring serves as a moderator for the prediction of alcohol use among high risk-taking athletes specifically.

Conclusion

The present study provided evidence that high risk-taking in adolescence does not necessarily equate to higher levels of substance use. Parental monitoring and school bonding were associated with decreased risk for substance use, even (and in many cases especially)

among the highest risk takers. Sports participation was a risk factor for alcohol use for most groups, providing evidence that sports may be contraindicated for substance use prevention among high risk takers in particular and adolescents in general. The protective and promotive effects found in the present study suggest that risk-taking during adolescence should not be considered as necessarily maladaptive; future research should consider what parents and schools can do to moderate the effects of high risk-taking, and what types of risk takers exist in order to assist in the design of appropriate prevention and intervention strategies.

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Figure 1.

Final structural model with risk-taking by gender interactions on alcohol use in grade 8.

Notes. Coefficients for *high risk-takers* are in *italics*, coefficients for **males** are in **bold**; * $p < .05$; ** $p < .01$; *** $p < .001$; $R^2 = 4\%$ (high risk takers) and 2% (low/average risk takers)

Figure 2.

Final structural model with risk-taking by gender interactions on alcohol use in grade 10.

Notes. Coefficients for *high risk-takers* are in *italics*, coefficients for **males** are in **bold**; * $p < .05$; ** $p < .01$; *** $p < .001$; $R^2 = 2\%$ (male high risk takers), 4% (male low/average risk takers), 62% (female high risk takers), and 18% (female low/average risk takers)

Figure 3.

Final structural model with risk-taking by gender interactions on marijuana use in grade 8.

Notes. Coefficients for *high risk-takers* are in *italics*, coefficients for **males** are in **bold**; * $p < .05$; ** $p < .01$; *** $p < .001$; $R^2 = 2\%$ (male high risk takers), 1% (all other groups)

Figure 4.

Final structural model with risk-taking by gender interactions on marijuana use in grade 10.

Notes. Coefficients for *high risk-takers* are in *italics*, coefficients for **males** are in **bold**; * $p < .05$; ** $p < .01$; *** $p < .001$; $R^2 = 1\%$ (male high risk takers), 2% (male low/average risk takers), 57% (female high risk takers), and 11% (female low/average risk takers)

Table 1

Descriptive Statistics and Standardized Measurement Model Parameter Values

Eighth Grade							
Construct	Variable	Factor Loading	Unique Variance	High Risk Takers		Low Risk Takers	
				Males (n=1327)	Females (n=806)	Males (n=7379)	Females (n=8688)
Sports Participation ^a	Extent of participation	0.95	0.10	3.13(1.77)	2.89(1.77)	3.12(1.74)	2.97(1.74)
School Bonding	Enjoy being in school	0.83	0.30	2.79(1.20)	3.03(1.16)	3.06(1.06)	3.44(1.01)
	Hate being in school (Reversed)	0.77	0.41	2.46(1.19)	2.56(1.17)	2.86(1.15)	3.11(1.08)
Parent Monitoring	Find work interesting	0.59	0.66	2.46(1.15)	2.46(1.09)	2.71(1.05)	2.84(0.98)
	Know where after school	0.73	0.47	4.12(1.10)	4.18(1.04)	4.45(0.88)	4.61(0.72)
	Know who with at night	0.87	0.25	4.03(1.17)	3.98(1.20)	4.38(0.99)	4.55(0.82)
	Know where at night	0.88	0.23	3.90(1.22)	3.95(1.16)	4.36(0.97)	4.54(0.82)
Alcohol Use ^a	Frequency of use in past 30 days	0.95	0.10	1.74(1.21)	1.93(1.33)	1.27(0.79)	1.28(0.71)
	Frequency of use in past 30 days	0.95	0.10	1.51(1.30)	1.40(1.03)	1.17(0.76)	1.12(0.59)
Tenth Grade							
Construct	Variable	Factor Loading	Unique Variance	High Risk Takers		Low Risk Takers	
				Males (n=1153)	Females (n=652)	Males (n=7550)	Females (n=8959)
Sports Participation ^a	Extent of participation	0.95	0.10	3.18(1.79)	2.76(1.78)	3.12(1.75)	2.81(1.77)
School Bonding	Enjoy being in school	0.83	0.31	2.76(1.14)	3.07(1.11)	3.05(1.01)	3.28(0.97)
	Hate being in school (Reversed)	0.77	0.41	2.49(1.14)	2.61(1.14)	2.86(1.08)	2.94(1.03)
Parent Monitoring	Find work interesting	0.56	0.69	2.43(1.04)	2.51(0.99)	2.70(0.96)	2.81(0.91)
	Know where after school	0.70	0.52	4.05(1.04)	4.09(1.08)	4.25(0.89)	4.51(0.74)

	Know who with at night	0.86	0.27	3.90(1.17)	3.92(1.16)	4.16(0.99)	4.44(0.83)
	Know where at night	0.88	0.22	3.75(1.21)	3.77(1.20)	4.06(1.02)	4.28(0.91)
Alcohol Use ^a	Frequency of use in past 30 days (1-7)	0.95	0.10	2.26(1.55)	2.35(1.40)	1.66(1.17)	1.58(1.01)
Marijuana Use ^a	Frequency of use in past 30 days (1-7)	0.95	0.10	1.99(1.77)	2.02(1.66)	1.48(1.29)	1.31(0.98)

^aUnique variance fixed to 10% of total variance

Table 2

Summary of Multi-Group Model Fit Indices

	χ^2 test			Change in χ^2 test		
	χ^2	df	p	$\Delta \chi^2$	Δdf	p
Eighth Grade						
<i>Alcohol Use</i>						
Fully Constrained Model	18508.99	438	<.001			
Factor Variances and Structural Paths Released ^a	12160.66	369	<.001	-6348.33	69	<.001
<i>Marijuana Use</i>						
Fully Constrained Model	18618.34	438	<.001			
Factor Variances and Structural Paths Released ^a	11184.04	369	<.001	-7434.30	69	<.001
Tenth Grade						
<i>Alcohol Use</i>						
Fully Constrained Model	6731.50	438	<.001			
Factor Variances and Structural Paths Released ^b	4669.72	393	<.001	-2061.78	45	<.001
<i>Marijuana Use</i>						
Fully Constrained Model	7714.69	438	<.001			
Factor Variances and Structural Paths Released ^b	4014.48	393	<.001	-3700.19	45	<.001

^aFactor covariances and factor loadings of individual variables remained constrained.

^bFactor covariances, factor loadings of individual variables, and the effects of the covariates on the specified outcome remained constrained.