

RESEARCH ARTICLE

Sensation seeking and adolescent drinking: Do protective behavioral strategies lower risk?

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Abstract

Using a cross-sectional design, we examined protective behavioral strategies (PBS) as a moderator of the relationship between sensation seeking and hazardous drinking and alcohol-related consequences among high school seniors ($N = 212$). Hierarchical regression analyses indicated sensation seeking was a significant predictor of binge drinking ($\beta = 0.65, p < 0.001$), prepartying ($\beta = 0.71, p < 0.001$), gaming ($\beta = 0.75, p < 0.001$), and alcohol-related consequences ($\beta = 0.69, p < 0.001$). Further, PBS moderated these relationships such that among high sensation seeking adolescents, PBS use was associated with better outcomes, including lower levels of binge drinking ($\beta = -0.37, p < 0.01$), prepartying ($\beta = -0.44, p < 0.01$), gaming ($\beta = -0.31, p < 0.05$), and alcohol-related consequences ($\beta = -0.53, p < 0.001$). We discuss counseling implications, including assessment and harm reduction strategies focusing on PBS to reduce hazardous drinking among high sensation seeking adolescents.

KEYWORDS

adolescents, alcohol use, hazardous drinking, sensation seeking, protective behavioral strategies

SENSATION SEEKING AND ADOLESCENT DRINKING: DO PROTECTIVE BEHAVIORAL STRATEGIES LOWER RISK?

Underage drinking is a significant problem in the United States, with 58.5% of adolescents reporting alcohol use by their senior year (Johnston et al., 2019). Among high school students, seniors have the highest rates of alcohol use, with 30.2% of seniors reporting alcohol use in the past 30 days, 13.8% reporting binge drinking in the past 2 weeks, and 42.9% reporting being drunk at least once in their lifetime (Johnston et al., 2019). Further, hazardous drinking is more prevalent among older high school students, with the highest rates of risky drinking practices (i.e., prepartying and drinking games) occurring among 17–19-year-olds (Borsari et al., 2013; Zamboanga et al., 2016). Researchers have also

found that risky patterns of drinking established in adolescence are predictive of heavy drinking (Kenney et al., 2010) and alcohol-related problems (Kenney et al., 2010; Scaglione et al., 2015) in college and young adulthood (Enstad et al., 2019), as well as with alcohol dependence later in life (Marshall, 2014).

Adolescent alcohol use is associated with a wide range of negative socioemotional consequences. For example, adolescent alcohol use is associated with academic problems (Rasberry et al., 2017), poor school attendance (Patte et al., 2017), and failure to complete high school (Kelly et al., 2015; Wang & Fredricks, 2014). Further, among adolescents, alcohol consumption is associated with being a target of violence, including school bullying (Doumas, Midgett et al., 2017; Johnston et al., 2017), dating violence (Miller et al., 2007), and unwanted sexual activity (Arata et al., 2003), attempting suicide (Miller et al., 2007), and drinking and driving

(Borsari et al., 2013). Researchers have also found that substance use increases depression and suicidality for adolescents who have experienced interpersonal trauma (Terrell et al., 2021). Finally, hazardous drinking practices (e.g., prepartying and gaming) in high school are associated with extreme drinking (e.g., 8+/10+ drinks for females and males, respectively; Fairlie et al., 2015) having a hangover, and passing out (Borsari et al., 2013).

Adolescence is a time of dynamic brain reorganization that makes adolescents particularly vulnerable to the negative effects of alcohol (Crews et al., 2019; Spear, 2018). Adolescent alcohol consumption is associated with deficits in sleep, cognitive flexibility, attention, memory, verbal learning, visuospatial ability, and psychomotor speed (Hanson et al., 2011; Nguyen-Louie et al., 2015; Spear, 2018). Neurologically, alcohol consumption disrupts healthy adolescent brain development by way of inhibiting neurogenesis, varying grey and white matter volumes, altering connections between frontal and limbic brain regions, inducing neuroinflammation, and initiating whole-brain changes in electroencephalogram (EEG) activity (Spear, 2018). These changes occur specifically in the range of theta wave (4–6 Hz) activity bandwidth (Rangaswamy et al., 2002), which has been associated with cortical decay (Coutin-Churchman et al., 2006; Saletu-Zyhlarz et al., 2004), suggesting alcohol misuse may lead to difficulties with decision making and impulse control.

Sensation seeking

One explanation for adolescent alcohol use is enhanced sensation seeking (Romer et al., 2017). Sensation seeking is defined as a biologically based personality trait manifested as the tendency to seek out novel, exciting stimuli, including risk-taking behavior (Zuckerman 1979, 1994). Adolescents' desire to explore the environment and engage in new learning is an adaptive function of development and likely results, in part, from increases in dopaminergic activation that naturally occur during adolescence (Romer et al., 2017). Although it is developmentally adaptive for adolescents to engage in some sensation seeking behavior, when paired with impulsivity (e.g., developmental deficits in cognitive control), it can lead to problematic behaviors, such as alcohol use (Khurana et al., 2018; Meeus et al., 2021; Romer et al., 2017).

Researchers have found that among adolescents, sensation seeking is associated with higher levels of alcohol use (MacPherson et al., 2010; Sznitman & Engel-Yeger, 2017), binge drinking, and alcohol-related consequences (Doumas, Miller et al., 2017). Further, sensation seeking and impulsivity levels are higher among individuals aged 16 and up convicted of driving while intoxicated/driving while under the influence (DWI/DWUI) compared to those without DWI/DWUI convictions who report similar levels of alcohol use (Curran et al., 2010). Sensation seeking has also been identified as a promising marker for identifying adolescents who are at risk for initiating binge drinking (Sargent et al., 2010). Sensation seeking is also associated with early onset

(Jensen et al., 2017; Malmberg et al., 2012) and higher levels of substance use (Bekman et al., 2010), as well as problems associated with substance use (Ortin et al., 2012). This is particularly important as early initiation of alcohol use is associated with neurodevelopmental changes in cognition, brain structure, and function (Lisdahl et al., 2013), increased risk of alcohol use and binge drinking later in adolescence (Aiken et al., 2017), and alcohol-related problems in young adulthood (Enstad et al., 2019).

Protective behavioral strategies

Researchers have examined protective factors to minimize risks associated with adolescent alcohol use. For example, researchers have identified protective behavioral strategies (PBS) as a way to buffer adolescents from alcohol-related consequences (Martens et al., 2005). PBS include strategies that occur before, during, or after drinking, including creating plans to stop or slow down drinking, changing how one drinks to avoid rapid alcohol consumption, and behaving in ways that decrease dangerous consequences and promote harm reduction (Martens et al., 2005). Researchers conducting studies with college students have found that using PBS is associated with lower levels of negative alcohol outcomes (Araas & Adams, 2008; Borden et al., 2011; Kenney & LaBrie, 2013; Zeigler-Hill et al., 2012). Further, among college students, using PBS moderates the relationship between self-regulation (D'Lima et al., 2012) and negative urgency (e.g., acting rashly when distressed) and alcohol-related consequences (Weaver et al., 2012); students with low levels of self-regulation and high levels of negative urgency who use PBS have fewer alcohol-related consequences than students who are less likely to use PBS.

Although some researchers have identified the buffering effects of PBS for college students with traits associated with impulsivity (i.e., self-regulation and negative urgency), we could find only one study examining the relationship between PBS and alcohol use among high sensation seeking adolescents (Doumas, Miller et al., 2017). Results from this study indicated that among high sensation seeking adolescents, PBS use was inversely associated with binge drinking and alcohol-related consequences (Doumas, Miller et al., 2017). Although this study provides support for the use of PBS to minimize high-risk drinking and the associated consequences, the study included several limitations. First, the sample included nondrinkers. Because nondrinkers, by definition, do not use PBS, research conducted specifically with adolescents who report alcohol use is warranted. Additionally, researchers used the PBS Scale (PBSS; Martens et al., 2005) to measure PBS. A revised version of the scale is now available and captures additional behaviors related to harm reduction and has improved internal consistency (Treloar et al., 2015). Finally, the researchers assessed hazardous drinking using one measure (i.e., binge drinking). Researchers have found that adolescents engage in other hazardous drinking behaviors including prepartying (e.g.,

consuming alcohol prior to attending a planned event) and gaming (e.g., playing drinking games that often include rapid alcohol consumption), practices that are related to higher levels of alcohol use and are predictive of heavy alcohol use and alcohol-related problems in college (Kenney et al., 2010).

The role of the counselor

Adolescence is a critical time to identify and intervene in alcohol misuse (Curtis et al., 2014). Counselors can be a source of support for adolescents in many areas of their lives, including concerns regarding alcohol use (Brooks & McHenry, 2015). Counselors may also be the first professional contact for an adolescent engaging in alcohol misuse, particularly in the schools (Burrow-Sanchez & Lopez, 2009). Additionally, researchers have found that screening, assessment, and brief interventions are effective for reducing alcohol use among adolescents (Mitchell et al., 2013; Patton et al., 2014). Thus, counselors in school and community settings are well-positioned to address adolescent alcohol use through assessment and the integration of harm reduction strategies into treatment planning decisions. Because the prevalence rates of alcohol use and heavy drinking increase thorough adolescence, counselors working with this age group need to be able to identify risk factors for adolescent alcohol use, including sensation seeking traits. Counselors are also in a unique position to be able to provide and design treatment plans that include strategies high-risk adolescents can use to minimize the negative consequences associated with hazardous drinking. Thus, it is important for counselors to understand the relationship between sensations seeking and hazardous drinking and the impact PBS can have on reducing hazardous drinking and the negative associated consequences for high sensation seeking adolescents.

THE CURRENT STUDY

The purpose of this study was to extend the literature by examining the moderating effects of PBS on the relationship between sensation seeking and hazardous drinking and alcohol-related consequences among high school seniors who report alcohol use. We selected high school seniors as they are at greatest risk for hazardous drinking and the negative associated outcomes among school-aged students. To address the limitations in prior research, we only included high school seniors who reported alcohol use, we utilized the revised PBSS scale (PBSS-20; Treloar et al., 2015), and we included three measures of hazardous drinking (i.e., binge drinking, prepartying, and gaming), as well as alcohol-related consequences. We hypothesized that (1) sensation seeking would be positively related to hazardous drinking and alcohol-related consequences and (2) PBS would moderate this relationship, such that among high sensation seeking adolescents, those using PBS would report lower levels of hazardous drinking and alcohol-related consequences than adolescents using fewer PBS.

METHOD

Research design

We used a cross-sectional design to examine the relationships between sensation seeking, PBS, hazardous drinking, and alcohol-related consequences. All study procedures were approved by the University Institutional Review Board and the School District Research Board.

Participants

Participants in the current study were high school seniors recruited from two high schools in the Northwest. Consent forms were sent to parents of all students ($N = 867$), including those who were 18 years old, per School District Research Board policy. A total of 342 (39.4%) parents provided consent. Among students with parental consent, those who were in attendance at school ($N = 330$) were given an opportunity to participate. Among these students, 311 (48.8% male, 51.2% female) provided assent. Of these, 68.2% ($N = 212$) reported alcohol use in the past year and met inclusion criteria for the study. Participant ages ranged from 15 to 18 ($M = 17.15$, $SD = 0.47$). Participants were primarily White (85.8%), with 4.7% Hispanic, 3.8% Asian, 1.4% Black, 1.9% American Indian/Alaskan Native, and 2.4% other. Among participants, 60.4% reported living with both parents, 18.9% reported living primarily with their mother, 7.5% reported living primarily with their father, and 13.2% reported other for their living situation.

Procedure

A member of the research team contacted the principals at two of the largest high schools within the capitol district in a northwest region of the United States. The schools contacted all parents of seniors via letter by mail at their permanent addresses provided by the registrar's office. The letter included a parental consent form and a project-addressed, stamped envelope for parents to return signed consent forms indicating permission (yes/no) for their adolescent to participate in the study. The letter also contained a phone number and email address so that parents could ask questions prior to signing the consent form. The school sent reminder letters to the student's home address and gave student reminder letters to give to their parents.

A member of the research team recruited students during a common core class period. Students with parental consent met at the school's computer lab to participate in the study. A member of the research team described the study and invited the students to participate. Students logged onto the survey website where they read a welcome screen explaining the research and were asked for their assent to participate. Once students gave assent by clicking "Agree," they were directed to begin the survey, which took approximately 20 min to

complete. Students who did not have parental consent remained in their classroom with their teacher and completed an alternative exercise. Students who did not provide assent went back to their classrooms where they joined the other students and teacher. Incentives included \$100 for school supplies and a pizza or bagel “party” for classrooms that achieved a 60% parental consent return rate.

Measures

Demographic survey

Participants completed a brief demographic questionnaire with questions about age, gender, and race/ethnicity.

Binge drinking

We defined frequency of binge drinking as consuming 5+ drinks in a row for males and 3+ for females in a 2-h period during the last 2 weeks. The 5/3 quantity has been identified as appropriate for adolescents aged 16–17 based on blood alcohol concentration (BAC) levels for this age group (Donovan, 2009).

Prepartying

We defined prepartying as “drinking before you go out to your planned destination (e.g., party, bar, or concert) at which more alcohol may or may not be consumed.” Participants responded to the following question: “On occasions when you pre-partied, how many drinks did you typically consume overall (includes drinks consumed during and after prepartying)?” This measure has been used in research with high school students (Kenney et al., 2010).

Gaming

We defined gaming as “games where drinking is part of the known rules, or where chugging is involved. The object of the game is either to avoid drinking or to show that you can drink a lot. A secondary aim is to get others to drink a lot.” Participants responded to the following question: “On occasions when you played drinking games, how many drinks did you typically consume overall (includes drinks consumed during and after playing drinking games)?” This measure has been used in research with high school students (Kenney et al., 2010).

Alcohol-related consequences

We assessed alcohol-related consequences using the Rutgers Alcohol Problem Index (RAPI; White & Labouvie,

1989). The RAPI is a 23-item self-administered screening tool for assessing adolescent problem drinking. Participants were asked “How many times have the following scenarios happened to you while you were consuming alcohol or as a result of your drinking in the past 30 days.” Responses were measured on a 5-point scale ranging from never to more than 10 times. A total consequence score was created by summing the 23 items. The RAPI has good internal consistency ($\alpha = 0.92$) (White & Labouvie, 1989) and test-retest reliability ($r = 0.83, .86$, and 0.88 for 1 month, 6 months, and 1 year, respectively) (Miller et al., 2002). The RAPI has been correlated significantly ($r = 0.49 - 0.67$) with several drinking variables (White & Labouvie, 1989). Coefficient alpha for this sample was $\alpha = 0.90$.

Sensation seeking

We used the Zuckerman–Kuhlman Personality Questionnaire (ZKPQ; Zuckerman et al., 1993) to assess sensation seeking. The ZKPQ is a 40-item forced choice questionnaire designed to measure five personality traits. For the purposes of this study, we used the 19-item Impulsive Sensation Seeking (ImpSS) subscale of the ZKPQ. The ImpSS items reflect a lack of planning (e.g., “I usually think about what I am going to do before doing it” reverse scored), a tendency to act impulsively (e.g., “I often do things on impulse”), a need for excitement and thrills (e.g., “I like to have new and exciting experiences and sensations even if they are a little frightening”), a preference for unpredictability (e.g., “I enjoy getting into new situations where you can’t predict how things will turn out”), and a need for novelty and change (e.g., “I tend to change interests frequently”). The ImpSS scale has been psychometrically validated, with Cronbach’s alpha ranging from $0.77 - 0.82$ (Zuckerman et al., 1993) and has been used in research with high school seniors ($\alpha = 0.77$) (Doumas, Miller et al., 2017). Cronbach’s alpha for this sample was $\alpha = 0.76$.

Protective behavioral strategies

We used the Protective Behavioral Strategy Scale-20 (PBSS-20; Treloar et al., 2015) to assess PBS. The PBSS-20 is a 20-item measure used to assess cognitive-behavioral strategies used to reduce risky drinking. Respondents rate the degree to which they engage in certain behaviors when consuming alcohol using a scale ranging from 1 (never) to 5 (always). The PBSS-20 scale has been psychometrically validated, with research demonstrating test-retest reliability ($r = 0.67$), content validity, and criterion-related validity (Treloar et al., 2015). The measure assesses three types of protective behaviors: Stopping/Limiting Drinking (e.g., “Determine not to exceed a set number of drinks,” “Stop drinking at a predetermined time,”), Manner of Drinking (e.g., “Avoid drinking games,” “Drink slowly, rather than gulp or chug,” “Avoid pre-gaming”), and Serious Harm Reduction (e.g., “Use a designated driver,” “Know where your drink has been at all times,”

TABLE 1 Means, standard deviations, and bivariate correlations for alcohol variable, sensation seeking, and protective behavioral strategies

Measure	1	2	3	4	5	6
1. Binge drinking	—					
2. Prepartying drinks	0.66**	—				
3. Gaming drinks	0.51**	0.65**	—			
4. Alcohol-related consequences	0.48**	0.56**	0.37**	—		
5. Sensation seeking	0.30**	0.32**	0.32**	0.25**	—	
6. Protective behavioral strategies	−0.06	−0.11	−0.12	−0.09	−0.01	—
M	1.12	3.78	3.58	4.34	28.14	66.61
SD	1.48	4.35	4.47	5.82	3.90	18.81

and “Only go out with people you know and trust”). All items are summed to create a total PBS scale. Cronbach’s alpha for this sample was $\alpha = 0.98$.

Power analysis

We conducted an a priori power analysis using the G*Power 3.1.3 program (Faul et al., 2007) for a hierarchical regression with three test variables and two control variables. Results indicated a sample size of 77 is needed for power of 0.80 to detect a medium effect size with an alpha level of 0.05. Thus, our final sample size of 212 is greater than the needed size to provide adequate power for our analyses.

Statistical analyses

We conducted all analyses using SPSS version 25. We examined the outcome and predictor variables for outliers and adjusted outliers to 3.3 SD above the mean before conducting analyses (Tabachnick & Fidell, 2007). We conducted bivariate correlations among predictor and dependent variables prior to conducting the main regression analyses (see Table 1). Although several of the correlations were significant at $p < 0.01$, the variance inflation factor (VIF) ranged between 1.0 – 5.6, with corresponding tolerance levels ranging from 0.18 – 0.99. The VIF is below the rule of thumb of $VIF < 10$ (Norman & Streiner, 2008), suggesting acceptable levels of multicollinearity among the predictor variables.

We also examined demographic differences in drinking variables, sensation seeking, and protective behavioral strategies. Gender was significantly related to binge drinking, with females reporting higher levels of binge drinking ($M = 1.32$, $SD = 1.51$) than males ($M = 0.86$, $SD = 1.40$), $t(211) = -2.26$, $p < .03$, Cohen’s $d = 0.32$. This is consistent with current prevalence rates of binge drinking among high school seniors in the United States, with 23.3% of females reporting binge drinking compared to 21.5% of males (Center for Disease Control [CDC], 2019). Race/ethnicity was dichotomized into White and participants of color due to low frequency of participants reporting several race/ethnicity categories. Race/ethnicity was significantly related to binge drinking, prepartying, and gaming, with White participants

reporting higher levels of binge drinking ($M = 1.23$, $SD = 1.54$) than participants of color, ($M = 0.43$, $SD = 0.68$), $t(211) = -2.76$, $p < .01$, Cohen’s $d = 0.67$, White participants reporting higher levels of prepartying ($M = 4.03$, $SD = 4.35$) than participants of color, ($M = 2.20$, $SD = 4.10$), $t(211) = -2.15$, $p < 0.03$, Cohen’s $d = 0.43$, and White participants reporting higher levels of gaming ($M = 3.90$, $SD = 4.60$) than participants of color, ($M = 1.57$, $SD = 3.00$), $t(211) = -2.68$, $p < 0.01$, Cohen’s $d = 0.59$. Thus, we included gender and race/ethnicity as control variables in the regression analyses. Means and standard deviations for drinking variables, sensation seeking, and protective behavioral strategies are presented in Table 1.

Our aim was to test whether the relationship between sensation seeking and adolescent drinking behavior is moderated by PBS. To test this aim, we conducted a series of hierarchical regression analyses, with interaction effects used to test for moderation. We mean centered all predictor variables to reduce problems of multicollinearity introduced into equations containing interaction terms (Aiken & West, 1991). We created the interaction term by computing the product of sensation seeking and PBS. Gender and race/ethnicity were entered at Step 1, sensation seeking and PBS were entered at Step 2, and the sensation seeking $\times$ PBS interaction term was entered at Step 3 to examine the moderating effects of PBS. We used simple slopes to examine the direction and degree of significant interactions (Aiken & West, 1991). All analyses were conducted at $p < 0.05$. We calculated effect size using the R^2 with 0.01 considered small, 0.09 considered medium, and 0.25 considered large (Cohen, 1969). We controlled for Type 1 error by using the Holm–Bonferroni procedure (Holm, 1979). Tables 2 and 3 present regression model results.

RESULTS

Hazardous drinking

Binge drinking

The full regression equation was statistically significant for binge drinking, $F(5, 206) = 10.67$, $p < 0.001$. Examination of the adjusted R^2 indicates sensation seeking and PBS

TABLE 2 Summary of hierarchical regression analyses for hazardous drinking

Variable	<i>B</i>	95% CI for <i>B</i>		<i>SE B</i>	β	<i>R</i> ²	ΔR^2
		LL	UL				
Frequency of binge drinking							
Step 1						0.06**	0.06**
Gender	0.49	0.09	0.89	0.20	0.16*		
Race/Ethnicity	0.81	0.25	1.37	0.28	0.19**		
Step 2						0.19***	0.15***
Sensation Seeking	1.93	1.12	2.72	0.41	0.65***		
PBS	0.46	1.38	5.14	0.34	0.13		
Sensation Seeking $\times$ PBS	−1.15	−2.05	0.25	0.46	−0.37**		
Prepartying drinks consumed							
Step 1							
Gender	−0.12	−0.05	4.84	0.60	−0.01	0.01	0.01
Race/Ethnicity	1.82	0.14	3.50	0.85	0.15*		
Step 2						0.16***	0.16***
Sensation Seeking	6.18	3.78	8.58	1.23	0.71***		
PBS	1.73	−0.26	3.71	1.00	0.16		
Sensation Seeking $\times$ PBS	−3.97	−6.67	−1.28	1.37	−0.44**		
Gaming drinks consumed							
Step 1						0.05**	0.05**
Gender	−1.09	0.82	5.79	0.61	−0.12		
Race/Ethnicity	2.29	0.58	3.99	0.87	0.18**		
Step 2							
Sensation Seeking	5.13	2.64	7.61	1.26	0.57***	0.15***	0.12***
PBS	0.99	−1.07	3.04	1.04	0.09		
Sensation Seeking $\times$ PBS	−2.91	−5.70	−0.12	1.42	−0.31*		

Note: CI, confidence interval; *N*, 122; *SE*, standard error.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

TABLE 3 Summary of hierarchical regression analyses for alcohol-related consequences

Variable	<i>B</i>	95% CI for <i>B</i>		<i>SE B</i>	β	<i>R</i> ²	ΔR^2
		LL	UL				
Step 1						0.00	0.00
Gender	0.29	−1.31	1.89	0.81	0.02		
Race/Ethnicity	0.87	−1.41	3.14	1.15	0.05		
Step 2							
Sensation Seeking	8.04	4.73	11.35	1.68	0.69***	0.13***	0.11***
PBS	2.14	−0.60	4.88	1.39	0.15		
Sensation Seeking $\times$ PBS	−6.44	−10.17	−2.72	1.89	−0.53***		

Note: CI, confidence interval; *N*, 122; *SE*, standard error.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

accounted for 19% of the variance in binge drinking. As seen in Step 2, sensation seeking was a statistically significant predictor of binge drinking ($p < 0.001$). As hypothesized, higher levels of sensation seeking were associated with higher levels of binge drinking. Further, as seen in Step 3, the interaction

between sensation seeking and PBS was statistically significant ($p < 0.01$). Examination of the slopes in Figure 1 indicates that among high sensation seeking participants, those using more PBS reported lower levels of binge drinking than those using fewer PBS.

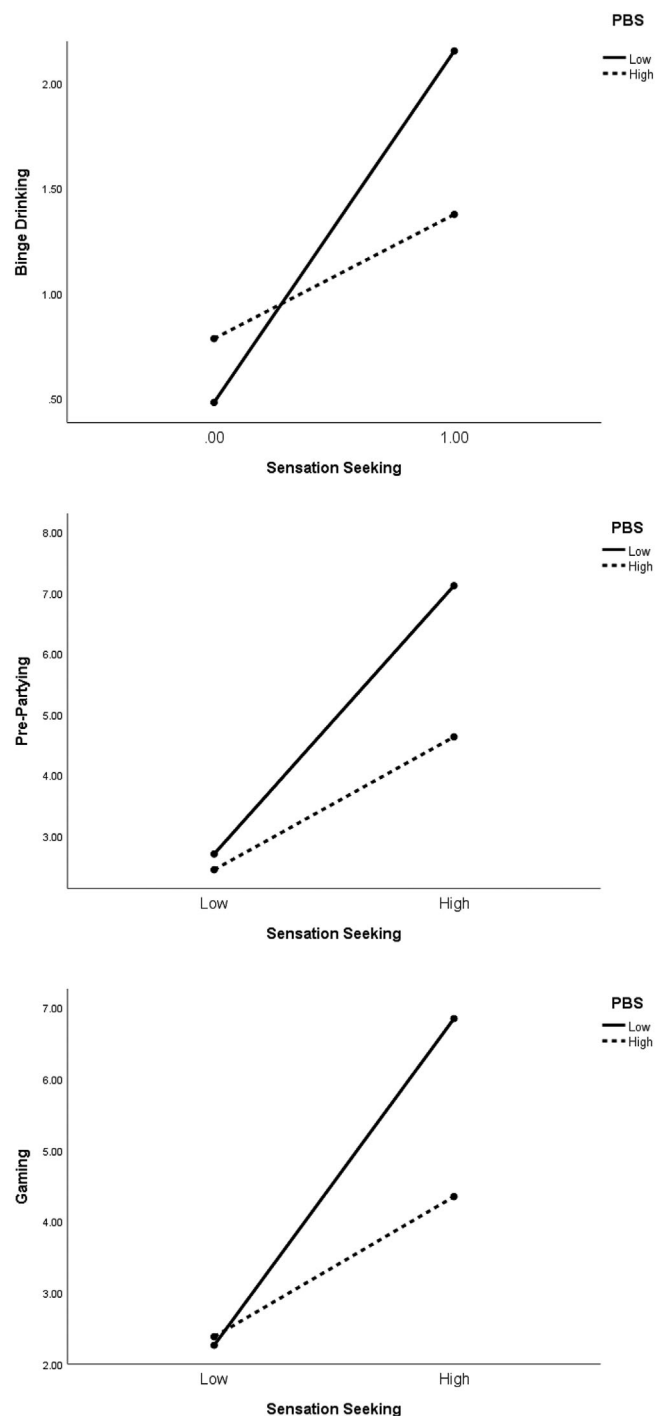


FIGURE 1 Means for hazardous drinking by sensation seeking and protective behavioural strategies (PBS)

Note: Simple slopes are shown depicting the direction and degree of the significant interaction testing moderator effects for frequency of binge drinking, total number of drinks consumed on prepartying occasions, and total number of drinks consumed on gaming occasions. When controlling for gender and race/ethnicity, among participants with high sensation seeking, those using more PBS reported less hazardous drinking than those using fewer PBS. The highest levels of hazardous drinking are reported by high sensation seeking students who report using PBS.

Prepartying

The full regression equation was statistically significant for prepartying, $F(5, 206) = 8.91, p < 0.001$. Examination of the adjusted R^2 indicates sensation seeking and PBS accounted for 16% of the variance in prepartying. As seen in Step 2, sensation seeking was a statistically significant predictor of the number drinks consumed on prepartying occasions ($p < 0.001$). As hypothesized, higher levels of sensation seeking were associated with more drinks consumed on prepartying occasions. Further, as seen in Step 3, the interaction between sensation seeking and PBS was statistically significant ($p < 0.01$). Examination of the slopes in Figure 1 indicates that among high sensation seeking participants, those using more PBS reported fewer drinks consumed on prepartying occasions than those using fewer PBS.

Gaming

The full regression equation was statistically significant for gaming, $F(5, 206) = 8.30, p < 0.001$. Examination of the adjusted R^2 indicates sensation seeking and PBS accounted for 15% of the variance in gaming. As seen in Step 2, sensation seeking was a statistically significant predictor of the number drinks consumed on gaming occasions ($p < 0.001$). As hypothesized, higher levels of sensation seeking were associated with more drinks consumed on gaming occasions. Further, as seen in Step 3, the interaction between sensation seeking and PBS was statistically significant ($p < 0.05$). Examination of the slopes in Figure 1 indicates that among high sensation seeking participants, those using more PBS reported fewer drinks consumed on gaming occasions than those using fewer PBS.

Alcohol-related consequences

The full regression equation was statistically significant for alcohol-related consequences, $F(5, 206) = 6.06, p < 0.001$. Examination of the adjusted R^2 indicates sensation seeking and PBS accounted for 13% of the variance in alcohol-related consequences. As seen in Step 2, sensation seeking was a statistically significant predictor of alcohol-related consequences ($p < 0.001$). As hypothesized, higher levels of sensation seeking were associated with higher levels of alcohol-related consequences. Further, as seen in Step 3 the interaction between sensation seeking and PBS was statistically significant ($p < 0.001$). Examination of the slopes in Figure 2 indicates that among participants with high sensation seeking, those using more PBS reported fewer alcohol-related consequences than those using fewer PBS.

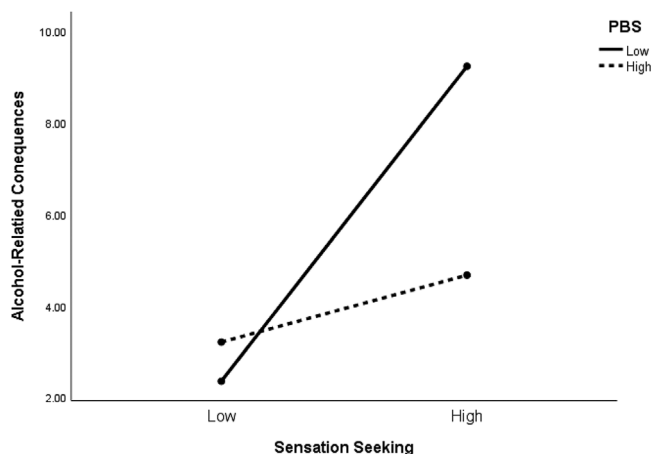


FIGURE 2 Means for alcohol-related consequences by sensation seeking and protective behavioural strategies (PBS)

Note: Simple slopes are shown depicting the direction and degree of the significant interaction testing moderator effects for alcohol-related consequences. When controlling for gender and race/ethnicity, among participants with high sensation seeking, those using more PBS reported fewer alcohol-related consequences than those using fewer PBS. The highest levels of alcohol-related consequences are reported by high sensation seeking students who report using PBS.

DISCUSSION

This study examined the moderating effects of PBS on the relationship between sensation seeking, hazardous drinking, and alcohol-related consequences among high school seniors. Findings from this study indicated sensation seeking was a statistically significant predictor of both hazardous drinking (i.e., binge drinking, prepartying, and gaming) and alcohol-related consequences. Effect sizes for all of the outcomes were in the medium to large range, suggesting the importance of the association of sensation seeking to high-risk drinking and the associated negative outcomes. These findings are consistent with research indicating high sensation seeking among adolescents is associated with high rates of substance use (MacPherson et al., 2010), early initiation of alcohol use (Doumas et al., 2019), greater severity of substance use (Bekman et al., 2010; Ortin et al., 2012; Urbán et al., 2008), binge drinking (Doumas, Miller et al., 2017; Sargent et al., 2010), and alcohol-related consequences (Doumas, Miller et al., 2017).

Results from the current study also indicate that among high sensation seeking adolescents, those using PBS reported less hazardous drinking and fewer alcohol-related consequences than those not using PBS. These findings replicate prior research conducted with high school seniors demonstrating PBS moderates the relationship between sensation seeking and binge drinking and alcohol-related consequences (Doumas, Miller et al., 2017). The current findings also extend the literature by demonstrating this relationship among a sample of drinkers (vs including nondrinkers) and using the PBSS-20 (Treloar et al., 2015) as the assessment measure. Results are also consistent with research suggesting PBS serve a protective function for college students with low-self regulation (D'Lima et al., 2012) and high levels of nega-

tive urgency (Weaver et al., 2012). Thus, results support prior research indicating PBS serve as a buffer against hazardous drinking and the negative alcohol outcomes associated with high sensation seeking.

We also extended the literature by examining two additional measures of hazardous drinking (i.e., prepartying and gaming). Including these variables in addition to binge drinking is important as both prepartying and gaming are associated with extreme drinking (Fairlie et al., 2015). Gaming is also associated with high-risk behaviors, such as “chugging” alcohol, posing immediate and serious health risks to adolescents engaging in this practice (Zamboanga et al., 2014). Although binge drinking can lead to serious consequences for adolescents, the risk is exacerbated when adolescents consume additional alcohol prior to attending social events or play drinking games that involve risky practices that include rapidly consuming large amounts of alcohol. Although research suggests playing drinking games is common among adolescents, the best indicators of risk include both total amount of alcohol consumed and psychological variables, such as impulsivity (Borsari et al., 2013). Thus, using PBS to reduce risky drinking practices, as well as the amount of alcohol consumed, is an important harm reduction strategy that can reduce negative outcomes associated with hazardous drinking among high sensation seeking adolescents.

Implications for counseling

Findings from this study have important implications for counselors. Results indicate high sensation seeking is related to hazardous alcohol use among adolescents, including binge drinking, prepartying, and gaming. Coupled with research indicating sensation seeking is associated with early age of drinking initiation (Jensen et al., 2017; Malmberg et al., 2012), it is important for school and community counselors to identify adolescents with high sensation seeking traits. High sensation seeking is associated with several behaviors that can help counselors identify high risk students. For example, high sensation seeking is associated with impulsive behavior, including engaging in high-risk activities, such as substance use, high-risk sexual activities, fighting, and extreme sports (Roberti, 2004) and drinking and driving (Curran et al., 2010). High sensation seeking is also related to a propensity for boredom, which can include affective (e.g., depressive affect), cognitive (e.g., inattention), and behavioral (e.g., disruptive behavior) components (Freund et al., 2021). School and community counselors who become aware of these indicators can offer further assessment of adolescents using tools such as the ZKPQ (Zuckerman et al., 1993).

Because sensation seeking is considered to be a biologically driven personality trait (Zuckerman, 1979, 1994), rather than trying to change sensation seeking tendencies, it may be more effective to use harm reduction strategies to teach high sensation seeking youth to minimize hazardous drinking and the associated negative consequences. Specifically,

results of this study indicate that using PBS moderates the relationship between sensation seeking and hazardous alcohol use. Thus, treatment planning for counselors can include teaching high sensation seeking adolescents to use PBS to reduce harm associated with alcohol use. When designing treatment plans for high sensation seeking adolescents, focusing on strategies specific to changing how one drinks, such as avoiding drinking games, shots, and gulping/chugging, avoiding mixing different types of alcohol, and not trying to out-drink others, may be most beneficial (Doumas, Miller et al., 2017). In contrast, strategies that are designed to stop or limit drinking, including planning ahead of time not to exceed a certain amount of drinks, stopping drinking at a certain time, or leaving a party at a predetermined time may be less effective for high sensation seeking adolescents (Doumas, Miller et al., 2017). Treatment planning can also include harm reduction strategies such as motivational enhancement approaches (Tevyaw & Monti, 2004) to work with adolescents to discuss how they have used PBS in the past and what new strategies they are willing to try in the future. Counselors can also plan to use technology based programs that include assessment and feedback related to PBS (e.g., eCHECKUP TO GO; <http://www.echeckuptogo.com/>), as research supports the efficacy of this approach in reducing alcohol use (Doumas, Esp et al., 2017) and alcohol-related consequences (Doumas et al., 2019) among adolescents who report hazardous drinking, as well as for adolescents who report early initiation of alcohol use (Doumas et al., 2016).

Limitations and directions for future research

This study adds to the limited literature examining PBS as a moderator of the relationship between sensation seeking and alcohol outcomes among adolescents. We do, however, note several limitations. First, due to a primarily White sample from the Northwest region, generalizability is limited. Second, information in this study was obtained through self-report. Self-reported alcohol use, however, is common practice in studies examining alcohol use among adolescents and researchers have demonstrated the reliability and validity of self-reported use in this age group (Flisher et al., 2004; Lintonen et al., 2004). We did, however, take specific steps to minimize social desirability and response bias, including providing assurances regarding confidentiality. Finally, we used a cross-sectional research design, limiting our ability to determine the direction of the relationships of interest. Although sensation seeking is presumed to be a biologically based personality trait, thus preceding alcohol use, it is possible that sensation seeking can also be an outcome of epigenetic factors such as psychological (Babad et al., 2019; Kerig, 2019) or physical (i.e., head injury; Liebel et al., 2021; O'Jile et al., 2004) trauma. Similarly, some researchers have suggested that similar epigenetic factors are associated with substance misuse (Jones et al., 2021) and that the relationship between epigenetic factors and addiction may be mediated by sensation seeking behavior (Hamilton & Nestler,

2019). Thus, we recommend future research using a longitudinal design to explore the nature of the relationship between sensation seeking and hazardous alcohol use in this age group.

CONCLUSION

This study extends the literature suggesting that PBS may buffer high sensation seeking adolescents from hazardous drinking and the associated negative consequences among high school seniors. These findings suggest school and community counselors can use brief personality-targeted interventions to motivate and support high sensation seeking adolescents to use skills to reduce excessive and rapid drinking.

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REFERENCES

- Aiken, A., Clare, P. J., Wadolowski, M., Hutchinson, D., Najman, J. M., Slade, T., Bruno, R., McBride, N., Kypri, K., & Mattick, R. P. (2017). Age of alcohol initiation and progression to binge drinking in adolescence: A prospective cohort study. *Alcoholism: Clinical and Experimental Research*, 40(1), 100–110. <http://doi.org/10.1111/acer.13525>
- Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Sage Publications.
- Araas, T. E., & Adams, T. B. (2008). Protective behavioral strategies and negative alcohol related consequences in college students. *Journal of Drug Education*, 38(3), 211–224. <http://doi.org/10.2190/DE.38.3.b>
- Arata, C. M., Stafford, J., & Tims, M. S. (2003). High school drinking and its consequences. *Adolescence*, 38(151), 567–579.
- Babad, S., Zwillling, A., Carson, K. W., Fairchild, V., Razak, S., Robinson, G., & Nikulina, V. (2019). Risk-taking propensity and sensation seeking in survivors of adverse childhood experiences. *Journal of Interpersonal Violence*, 36(19–20), NP10670–NP10687. <https://doi.org/10.1177/0886260519876035>
- Bekman, N. M., Cummins, K., & Brown, S. A. (2010). Affective and personality risk and cognitive mediators of initial adolescent alcohol use. *Journal of Studies on Alcohol and Drugs*, 71(4), 570–580. <https://doi.org/10.15288/jsad.2010.71.570>
- Borden, L. A., Martens, M. P., McBride, M. A., Sheline, K. T., Bloch, K. K., & Dude, K. (2011). The role of college students' use of protective behavioral strategies in the relation between binge drinking and alcohol-related problems. *Psychology of Addictive Behaviors*, 25(2), 346–351. <https://doi.org/10.1037/a0022678>

- Borsari, B., Zamboanga, B. L., Correia, C., Olthuis, J. V., Van Tyne, K., Zadworny, Z., Grossbard, J. R., & Horton, N. J. (2013). Characterizing high school students who play drinking games using latent class analysis. *Addictive Behaviors*, 38(10), 2532–2540. <https://doi.org/10.1016/j.addbeh.2013.04.009>
- Brooks, F., & McHenry, B. (2015). *A contemporary approach to substance use disorders and addiction counseling* (2nd ed.). Wiley.
- Burrow-Sanchez, J., & Lopez, A. (2009). Identifying substance abuse issues in high schools. A national survey of high school counselors. *Journal of Counseling and Development*, 87(1), 72–79. <https://doi.org/10.1002/j.1556-6678.2009.tb00551.x>
- Center for Disease Control and Prevention. (2019). *Youth Risk Behavior Surveillance System (YRBSS)*. <https://www.cdc.gov/healthyyouth/data/yrb/index.htm>
- Cohen, J. (1969). *Statistical power analysis for the behavioural sciences*. Academic Press.
- Coutin-Churchman, P., Moreno, R., Añez, Y., & Vergara, F. (2006). Clinical correlates of quantitative EEG alterations in alcoholic patients. *Clinical Neurophysiology*, 117(4), 740–751. <http://doi.org/10.1016/j.clinph.2005.12.021>
- Crews, F. T., Robinson, D. L., Chandler, L. J., Ehlers, C. L., Mulholland, P. J., Pandey, S. C., Rodd, Z. A., Spear, L. P., Swartzwelder, H. S., & Vetreno, R. P. (2019). Mechanisms of persistent neurobiological changes following adolescent alcohol exposure: NADIA consortium findings. *Alcoholism: Clinical and Experimental Research*, 43(9), 1806–1822. <http://doi.org/10.1111/acer.14154>
- Curran, M. F., Fuertes, J. N., Alfonso, V. C., & Hennessy, J. J. (2010). The association of sensation seeking and impulsivity to driving while under the influence of alcohol. *Journal of Addictions & Offender Counseling*, 30(2), 84–98. <https://doi.org/10.1002/j.2161-1874.2010.tb00059.x>
- Curtis, B. L., McLellan, A. T., & Gabellini, B. N. (2014). Translating SBIRT to public school settings: An initial test of feasibility. *Journal of Substance Abuse Treatment*, 46, 15–21. <https://doi.org/10.1016/j.jsat.2013.08.001>
- D'Lima, G. M., Pearson, M. R., & Kelley, M. L. (2012). Protective behavioral strategies as a mediator and moderator of the relationship between self-regulation and alcohol-related consequences in first-year college students. *Psychology of Addictive Behaviors*, 26(2), 330–337. <https://doi.org/10.1037/a0026942>
- Donovan, J. E. (2009). Estimated blood alcohol concentrations for child and adolescent drinking and their implications for screening instruments. *Pediatrics*, 123(6), 975–981. <https://doi.org/10.1542/peds.2008-0027>
- Doumas, D. M., & Esp, S. (2019). Reducing alcohol-related consequences among high school seniors: Efficacy of a brief, web-based intervention. *Journal of Counseling & Development*, 97(1), 53–61. <https://doi.org/10.1002/jcad.12235>
- Doumas, D. M., Esp, S., Flay, B., & Bond, L. (2017). A randomized controlled trial testing the efficacy of a brief online alcohol intervention for high school seniors. *Journal of Studies on Alcohol and Drugs*, 78(5), 706–715. <https://doi.org/10.15288/jsad.2017.78.706>
- Doumas, D. M., Hausheer, R., & Esp, S. (2016). Age of drinking initiation as a moderator of the efficacy of a brief, web-based personalized feedback alcohol intervention. *Journal of Child and Adolescent Substance Abuse*, 25(6), 591–597. <https://doi.org/10.1080/1067828X.2016.1171185>
- Doumas, D. M., Midgett, A., & Johnston, A. D. (2017). Substance use and bullying victimization among middle and high school students: Is positive school climate a protective factor?. *Journal of Addictions & Offender Counseling*, 38(1), 2–15. <https://doi.org/10.1002/jaoc.12025>
- Doumas, D. M., Miller, R., & Esp, S. (2017). Impulsive sensation seeking, binge drinking, and alcohol-related consequences: Do protective behavioral strategies help high risk adolescents? *Addictive Behaviors*, 64, 6–12. <https://doi.org/10.1016/j.addbeh.2016.08.003>
- Doumas, D. M., Turrissi, R., Miller, R., Esp, S., & Flay, B. (2019). Age of drinking initiation as a mediator of the relationship between sensation seeking and heavy drinking among high school seniors. *Journal of Child and Adolescent Substance Abuse*, 28(1), 32–38. <https://doi.org/10.1080/1067828X.2018.1561579>
- Enstad, F., Evans-Whipp, T., Kjeldsen, A., Toumbourou, J. W., & Von Soest, T. (2019). Predicting hazardous drinking in late adolescence/young adulthood from early and excessive adolescent drinking – a longitudinal cross-national study of Norwegian and Australian adolescents. *BMC Public Health*, 19(1), 1–12. <https://doi.org/10.1186/s12889-019-7099-0>
- Fairlie, A. M., Maggs, J. L., & Lanza, S. T. (2015). Prepartying, drinking games, and extreme drinking among college students: A daily-level investigation. *Addictive Behaviors*, 42(1), 91–95. <https://doi.org/10.1016/j.addbeh.2014.11.001>
- Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, 39(2), 175–191. <https://doi.org/10.3758/BF03193146>
- Flisher, A. J., Evans, J., Muller, M., & Lombard, C. (2004). Brief report: Test-retest reliability of self-reported adolescent risk behavior. *Journal of Adolescence*, 27(2), 207–212. <https://doi.org/10.1016/j.adolescence.2001.10.001>
- Freund, V. A., Schulenberg, J. E., & Maslowsky, J. (2021). Boredom by sensation-seeking interactions during adolescence: Associations with substance use, externalizing behavior, and internalizing symptoms in a US national sample. *Prevention Science*, 22, 555–566. <https://doi.org/10.1007/s11121-020-01198-0>
- Hamilton, P. J., & Nestler, E. J. (2019). Epigenetics and addiction. *Current Opinion in Neurobiology*, 59(1), 128–136. <https://doi.org/10.1016/j.conb.2019.05.005>
- Hanson, K. L., Medina, K. L., Padula, C. B., Tapert, S. F., & Brown, S. A. (2011). Impact of adolescent alcohol and drug use on neuropsychological functioning in young adulthood: 10-year outcomes. *Journal of Child & Adolescent Substance Abuse*, 20(2), 135–154. <https://doi.org/10.1080/1067828X.2011.555272>
- Holm, S. (1979). A simple sequentially rejective multiple test procedure. *Scandinavian Journal of Statistics*, 6(2), 65–70.
- Jensen, M., Chassin, L., & Gonzales, N. A. (2017). Neighborhood moderation of sensation seeking effects on adolescent substance use initiation. *Journal of Youth and Adolescence*, 46, 1953–1967. <https://doi.org/10.1007/s10964-017-0647-y>
- Johnston, L. D., Miech, R. A., O'Malley, P. M., Bachman, J. G., Schulenberg, J. E., & Patrick, M. E. (2019). *Monitoring the future national survey results on drug use 1975–2018: Overview, key findings on adolescent drug use*. Institute for Social Research, The University of Michigan. <http://www.monitoringthefuture.org/pubs/monographs/mtf-overview2018.pdf>
- Johnston, A. D., Doumas, D. M., Midgett, A., & Moro, R. R. (2017). Gender differences in the relationship between bullying victimization and substance use among high school students. *Journal of Child and Adolescent Counseling*, 3(1), 30–43. <https://doi.org/10.1080/23727810.2017.1280749>
- Jones, D. E., Park, J. S., Gamby, K., Bigelow, T. M., Mersha, T. B., & Folger, A. T. (2021). Mental health epigenetics: A primer with implications for counselors. *Professional Counselor*, 11(1), 102–121. <https://doi.org/10.1524/dej.11.1.102>
- Kelly, A. B., Evans-Whipp, T. J., Smith, R., Chan, G. C., Toumbourou, J. W., Patton, G. C., Hemphill, S. A., Hall, W. D., & Catalano, R. F. (2015). A longitudinal study of the association of adolescent polydrug use, alcohol use and high school non-completion. *Addiction*, 110(4), 627–635. <https://doi.org/10.1111/add.12829>
- Kenney, S. R., & LaBrie, J. W. (2013). Use of protective behavioral strategies and reduced alcohol risk: Examining the moderating effects of mental health, gender, and race. *Psychology of Addictive Behaviors*, 27(4), 997–1009. <https://doi.org/10.1037/a0033262>
- Kenney, S. R., Hummer, J. F., & LaBrie, J. W. (2010). An examination of prepartying and drinking game playing during high school and their impact on alcohol-related risk upon entrance into college. *Journal of Youth and Adolescence*, 39(9), 999–1011. <https://doi.org/10.1007/s10964-009-9473-1>
- Kerig, P. K. (2019). Linking childhood trauma exposure to adolescent justice involvement: The concept of posttraumatic risk-seeking. *Clinical Psychology: Science and Practice*, 26(3), e12280. <https://doi.org/10.1111/cpsp.12280>
- Khurana, A., Romer, D., Betancourt, L. M., & Hurt, H. (2018). Modeling trajectories of sensation seeking and impulsivity dimensions from

- early to late adolescence: Universal trends or distinct sub-groups? *Journal of Youth and Adolescence*, 47(1), 1922–2005. <https://doi.org/10.1007/s10964-018-0891-9>
- Liebel, S. W., Edwards, K. A., & Broglio, S. P. (2021). Sensation-seeking and impulsivity in athletes with sport-related concussion. *Current Psychiatry Reports*, 23(4), 1–6. <https://doi.org/10.1007/s11920-021-01232-0>
- Lintonen, T., Ahlstrom, S., & Metso, L. (2004). The reliability of self-reported drinking in adolescence. *Alcohol and Alcoholism*, 39(4), 362–368. <https://doi.org/10.1093/alcalc/agh071>
- Lisdahl, K. M. (2013). Dare to delay? The impacts of adolescent alcohol and marijuana use onset on cognition, brain structure, and function. *Frontiers in Psychiatry*, 4, 53. <https://doi.org/10.3389/fpsy.2013.00053>
- MacPherson, L., Magidson, J. F., Reynolds, E. K., Kahler, C. W., & Lejuez, C. W. (2010). Changes in sensation seeking and risk-taking propensity predict increases in alcohol use among early adolescents. *Alcoholism: Clinical and Experimental Research*, 34(8), 1400–1408. <https://doi.org/10.1111/j.1530-0277.2010.01223.x>
- Malmberg, M., Kleinjan, M., Vermulst, A. A., Overbeek, G., Monshouwer, K., Lammer, J., & Engels, R. C. M. (2012). Do substance use risk personality dimensions predict the onset of substance use in early adolescence? A variable- and person-centered approach. *Journal of Youth and Adolescence*, 41(11), 1512–1525. <https://doi.org/10.1007/s10964-012-9775-6>
- Marshall, E. J. (2014). Adolescent alcohol use: risks and consequences. *Alcohol and Alcoholism*, 49(2), 160–164. <https://doi.org/10.1093/alcalc/agt180>
- Martens, M. P., Ferrier, A. G., Sheehy, M. J., Corbett, K., Anderson, D. A., & Simmons, A. (2005). Development of the protective behavioral strategies survey. *Journal of Studies on Alcohol and Drugs*, 66(5), 698–705. <http://doi.org/10.15288/jsa.2005.66.698>
- Meeus, W., Vollebergh, W., Branje, S., Crocetti, E., Ormel, J., Crone, E. A., & Becht, A. (2021). On imbalance of impulse control and sensation seeking in adolescent risk: An intra-individual developmental test of systems and maturational imbalance models. *Journal of Youth and Adolescence*, 50(1), 827–840. <https://doi.org/10.1007/s10964-021-01419-x>
- Miller, E. T., Neal, D. J., Roberts, L. J., Baer, J. S., Cressler, S. O., Metrick, J., & Marlatt, G. A. (2002). Test-retest reliability of alcohol measures: Is there a difference between internet-based assessment and traditional methods? *Psychology of Addictive Behaviors*, 16, 56–63. <https://doi.org/10.1037/0893-164X.16.1.56>
- Miller, J. W., Naimi, T. S., Brewer, R. D., & Jones, S. E. (2007). Binge drinking and associated health risk behaviors among high school students. *Pediatrics*, 119(1), 76–85. <https://doi.org/10.1542/peds.2006-1517>
- Mitchell, S. G., Gryczynski, J., O'Grady, K. E., & Schwartz, R. P. (2013). SBIRT for adolescent drug and alcohol use: Current status and future directions. *Journal of Substance Abuse Treatment*, 44(5), 463–472. <https://doi.org/10.1016/j.jsat.2012.11.005>
- Nguyen-Louie, T. T., Castro, N., Matt, G. E., Squeglia, L. M., Brumback, T., & Tapert, S. F. (2015). Effects of emerging alcohol and marijuana use behaviors on adolescents' neuropsychological functioning over four years. *Journal of Studies on Alcohol and Drugs*, 76(5), 738–748. <http://doi.org/10.15288/jsad.2015.76.738>
- Norman, G. R., & Streiner, D. L. (2008). *Biostatistics: The bare essentials* (3rd ed.). B.C. Decker.
- O'Jile, J. R., Ryan, L. M., Parks-Levy, J., Betz, B., & Gouvier, W. D. (2004). Sensation seeking and risk behaviors in young adults with and without a history of head injury. *Applied Neuropsychology*, 11(2), 107–112. https://doi.org/10.1207/s15324826an1102_7
- Ortin, A., Lake, A. M., Kleinman, M., & Gould, M. S. (2012). Sensation seeking as risk factor for suicidal ideation and suicide attempts in adolescence. *Journal of Affective Disorders*, 143, 214–222. <https://doi.org/10.1016/j.jad.2012.05.058>
- Patte, K. A., Qian, W., & Leatherdale, S. T. (2017). Marijuana and alcohol use as predictors of academic achievement: A longitudinal analysis among youth in the COMPASS study. *Journal of School Health*, 87(5), 310–318. <https://doi.org/10.1111/josh.12498>
- Patton, R., Deluca, P., Kaner, E., Newbury-Birch, D., Phillips, T., & Drummond, C. (2014). Alcohol screening and brief intervention for adolescents: the how, what and where of reducing alcohol consumption and related harm among young people. *Alcohol and Alcoholism*, 49(2), 207–212. <https://doi.org/10.1093/alcalc/agt165>
- Rangaswamy, M., Porjesz, B., Chorlian, D. B., Wang, K., Jones, K. A., Bauer, L. O., & Reich, T. (2002). Beta power in the EEG of alcoholics. *Biological Psychiatry*, 52(8), 831–842. [https://doi.org/10.1016/s0006-3223\(02\)01362-8](https://doi.org/10.1016/s0006-3223(02)01362-8)
- Rasberry, C. N., Tiu, G. F., Kann, L., McManus, T., Michael, S. L., Merlo, C. L., Lee, S. M., Bohm, M. K., Annor, F., & Ethier, K. A. (2017). *Health-related behaviors and academic achievement among high school students—United States, 2015*. Centers for Disease Control and Prevention: Morbidity and Mortality Weekly Report (MMWR). <https://www.cdc.gov/mmwr/volumes/66/wr/mm6635a1.htm#contribAff>
- Romer, D., Reyna, V. F., & Satterwaite, T. D., (2017). Beyond stereotypes of adolescent risk taking: Placing the adolescent brain in developmental context. *Developmental Cognitive Neuroscience*, 27(1), 19–34. <https://doi.org/10.1016/j.dcn.2017.07.007>
- Roberti, J. W. (2004). A review of behavioral and biological correlates of sensation seeking. *Journal of Research in Personality*, 38(3), 256–279. [https://doi.org/10.1016/S0092-6566\(03\)00067-9](https://doi.org/10.1016/S0092-6566(03)00067-9)
- Saletu-Zylharz, G. M., Arnold, O., Anderer, P., Oberndorfer, S., Walter, H., Lesch, O. M., & Saletu, B. (2004). Differences in brain function between relapsing and abstaining alcohol-dependent patients, evaluated by EEG mapping. *Alcohol and Alcoholism*, 39(3), 233–240. <https://doi.org/10.1093/alcalc/agh041>
- Sargent, J. D., Tanski, S., Stoolmiller, M., & Hanewinkel, R. (2010). Using sensation seeking to target adolescents for substance use interventions. *Addiction*, 105(3), 506–514. <https://doi.org/10.1111/j.1360-0443.2009.02782.x>
- Scaglione, N. M., Mallett, K. A., Turrissi, R., Reavy, R., Cleveland, M. J., & Ackerman, S. (2015). Who will experience the most alcohol problems in college? The roles of middle and high school drinking tendencies. *Alcoholism: Clinical and Experimental Research*, 39(10), 2039–2046. <https://doi.org/10.1111/acer.12846>
- Spear, L. P. (2018). Effects of adolescent alcohol consumption on the brain and behaviour. *Nature Reviews Neuroscience*, 19(1), 197–214. <https://doi.org/10.1038/nrn.2018.10>
- Sznitman, S., & Engel-Yeger, B. (2017). Sensation seeking and adolescent alcohol use: Exploring the mediating role of unstructured socializing with peers. *Alcohol and Alcoholism*, 52(3), 396–401. <https://doi.org/10.1093/alcalc/agx008>
- Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Allyn and Bacon.
- Terrell, K. R., Zeglin, R. J., Palmer, R. E., Moore, M. J., & Barr, E. M. (2021). Interpersonal trauma in high school: Substance use as a moderator of depression and suicidality. *Journal of Child and Adolescent Counseling*, 7(1), 1–12. <https://doi.org/10.1080/23727810.2020.1835411>
- Tevyaw, T. O. L., & Monti, P. M. (2004). Motivational enhancement and other brief interventions for adolescent substance abuse: foundations, applications and evaluations. *Addiction*, 99, 63–75. <https://doi.org/10.1111/j.1360-0443.2004.00855.x>
- Treloar, H., Martens, M. P., & McCarthy, D. M. (2015). The Protective Behavioral Strategies Scale-20: Improved content validity of the Serious Harm Reduction subscale. *Psychological Assessment*, 27(1), 340–346. <https://doi.org/10.1037/pas0000071>
- Urbán, R., Kökönyei, G., & Demetrovics, Z. (2008). Alcohol outcome expectancies and drinking motives mediate the association between sensation seeking and alcohol use among adolescents. *Addictive Behaviors*, 33, 1344–1352. <https://doi.org/10.1016/j.addbeh.2008.06.006>
- Wang, M. T., & Fredricks, J. A. (2014). The reciprocal links between school engagement, youth problem behaviors, and school dropout during adolescence. *Child Development*, 85(2), 722–737. <https://doi.org/10.1111/cdev.12138>
- Weaver, C. C., Martens, M. P., & Smith, A. E. (2012). Do protective behavioral strategies moderate the relationship between negative urgency and alcohol-related outcomes among intercollegiate athletes? *Journal of Studies on Alcohol and Drugs*, 73(3), 498–503. <https://doi.org/10.15288/jsad.2012.73.498>

- White, H. R., Labouvie, E. W. (1989). Towards the assessment of adolescent problem drinking. *Journal of Studies on Alcohol*, 50(1), 30–37. <https://doi.org/10.15288/jsa.1989.50.30>
- Zamboanga, B. L., Olthuis, J. V., Kenney, S. R., Correia, C. J., Van Tyne, K., Ham, L. S., & Borsari, B. (2014). Not just fun and games: a review of college drinking games research from 2004 to 2013. *Psychology of Addictive Behaviors*, 28(3), 682–695. <https://doi.org/10.1037/a0036639>
- Zamboanga, B. L., Tomaso, C. C., Cloutier, R. M., Blumenthal, H., Kenney, S. R., & Borsari, B. (2016). Drinking game participation among high school and incoming college students. *Journal of Addictions Nursing*, 24(1), E1. <https://doi.org/10.1097/01.JAN.0000481966.33116.a5>
- Zeigler-Hill, V., Madson, M. B., & Ricedorf, A. (2012). Does self-esteem moderate the associations between protective behavioral strategies and negative outcomes associated with alcohol consumption?. *Journal of Drug Education*, 42(2), 211–227. <https://doi.org/10.2190/DE.42.2.f>
- Zuckerman, M. (1979). *Sensation seeking: Beyond the optimal level of arousal*. Lawrence Erlbaum.
- Zuckerman, M. (1994). *Behavioral expression and biosocial bases of sensation seeking*. Cambridge University Press.
- Zuckerman, M., Kuhlman, D.M., Joireman, J., Teta, P., & Kraft, M. (1993). A comparison of three structural models for personality: The big three, the big five, and the alternative five. *Journal of Personality and Social Psychology*, 65(4), 757–768. <https://doi.org/10.1037/0022-3514.65.4.757>

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