

**The Relationship Between Internalizing and Externalizing Behavior Problems and
Prospective Self on Adolescent Alcohol and Marijuana Use Occasions**

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A thesis submitted in partial fulfillment of the requirements of the Degree of Bachelor of
Arts with Honors in Psychology from the University of Michigan 2023.

April 1, 2023

Author Note

There is no conflict of interest to disclose.

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Acknowledgments

I would like to take this opportunity to thank my mentors, Dr. Daniel P. Keating and Dr. Sarah A. Stoddard, for their continued support and guidance throughout my thesis journey up to its completion. I can confidently say that Dr. Keating and Dr. Stoddard have greatly shaped my ongoing passion for research. Additionally, I would like to thank Dr. Cindy Lustig and Rachel Watson for their constant guidance throughout the year.

Abstract

Background: Adolescent alcohol and marijuana use present an increasing concern among researchers as the number of adolescents using these substances is substantial. **Objective:** This study aims to understand the effects of internalizing behavior problems, externalizing behavior problems, and prospective self on alcohol and marijuana use occurrences. **Methods:** We used data collected at ages 15–17 years old ($n=2017$). Two linear regression analyses were conducted to model the relationship between internalizing and externalizing behavior problems, prospective self (as predictor variables), and alcohol and marijuana use (as outcome variables), respectively. For each linear regression, the models were run, one for alcohol use and one for marijuana use. For model 2, covariate variables were included, and for model 3, interaction effects among the predictor variables were included. **Results:** For alcohol, a higher level of externalizing behavior problems was associated with a higher level of alcohol use occasions, while a higher level of prospective self was associated with a lower level of alcohol use occasions. For marijuana, a higher level of externalizing behavior problems was associated with a higher level of marijuana use occasions, while a higher level of internalizing behavior problems and prospective self was associated with a lower level of marijuana use occasions. **Conclusions:** These findings provide insight into risk and protective factors for alcohol and marijuana usage, which can inform the development of prevention and treatment programs.

Keywords: alcohol, marijuana, internalizing behavior problems, externalizing behavior problems, prospective self

The Relationship Between Internalizing and Externalizing Behavior Problems and Prospective Self on Adolescent Alcohol and Marijuana Use Occasions

Adolescent substance use is an ongoing issue nationwide. According to the National Center for Drug Abuse Statistics (NCDAS), 2.08 million (or 8.33%) adolescents (12–17 year-olds) reported using drugs in the last month; 83.88% of these adolescents reported using marijuana in the last month (*Teenage Drug Use Statistics [2023]*, 2023). Moreover, 4,777 Americans aged 15–24 years old died of an overdose of illicit drugs in one year, and of overdose deaths, 15–24 year-olds account for 11.2% of deaths (*Teenage Drug Use Statistics [2023]*, 2023). Marijuana is one of the most commonly used substances among adolescents (*Teenage Drug Use Statistics [2023]*, 2023). Around 35.2% of youth have used marijuana in the last year, and 43.7% of youth have tried marijuana in their lifetime (*Teenage Drug Use Statistics [2023]*, 2023).

Although it is illegal for individuals under 21 to consume alcohol, youth between the ages of 12 and 20 years old consume one-tenth of all the alcohol consumed in the United States (*Teen Substance Use & Risks*, 2020). Alcohol is the most commonly used substance, with 1.19 million adolescents and 11.72 million young adults (18–25-year-olds) reporting binge drinking in the last month (*Teenage Drug Use Statistics [2023]*, 2023). Moreover, 407,000 adolescents met the criteria for Alcohol Use Disorder (AUD).

Early or persistent use of substances poses many risks to adolescents' biological, psychological, and social development. According to the CDC, adolescents who drink alcohol are more likely to experience symptoms such as school problems, social problems, legal problems, physical problems, physical and sexual violence, increased risk of suicide and homicide, and long-term changes in brain development (*Underage Drinking | CDC*, 2022).

Externalizing and Internalizing Behavior Problems

Externalizing behavior problems include mental disorders that are characterized by “problematic behavior related to poor impulse control, including rule-breaking, aggression, impulsivity, and inattention” (Samek & Hicks, 2014, pg. 1). Numerous studies have identified associations between externalizing behavior problems and substance use (Couwenbergh et al., 2006; Miettunen et al., 2013; Oshri et al., 2011). According to the literature review conducted by Couwenbergh et al. (2006), externalizing behavior disorders—in particular, Conduct Disorder (CD)—were most consistently comorbid with Substance Use Disorders (SUD) among adolescents and young adults.

Internalizing behavior problems include psychopathological disorders that involve negative emotions, such as depression and anxiety. While internalizing problems are often considered a risk factor due to the use of substances for self-medication, internalizing problems can also play a protective role, as social withdrawal and fear of negative consequences can protect adolescents from engaging with deviant peers and substance use (Hussong et al., 2011). Therefore, it is suggested that internalizing problems can serve as either a protective factor or a risk factor during early adolescence. It has been proposed that the risk factor of self-medication may not emerge until late adolescence and early adulthood (Colder et al., 2012).

Much research has focused on both internalizing and externalizing behavior problems and their relationship with substance use (Colder et al., 2013; Colder et al., 2017; Miettunen et al., 2013). For example, Colder et al. (2013) found that exhibiting only externalizing behavior problems was the strongest predictor for alcohol, cigarette, and marijuana use, while exhibiting only internalizing behavior problems actually served as a protective factor against cigarette and marijuana use (Colder et al., 2013). Moreover, Miettunen and colleagues’ (2013) findings

suggest that externalizing behavior problems precede substance use for both adolescent males and females, while only for females, internalizing behaviors follow substance use.

Prospective Self

Prospective self is considered a protective factor and involves how one perceives themselves in the future. Prospective self was constructed by Zinn et al. (2020) to understand the essence upon which adolescents make decisions that influence their self-identity. Essentially, the construct of prospective self was formed from the assumption that adolescents' decisions influence how they identify their current and future selves (Zinn et al., 2020). Prospective self is measured using three constructs: (1) future orientation, (2) academic aspirations, and (3) exhibiting resistance to peer influence. According to their study, Zinn et al. (2020) found that externalizing behaviors negatively predicted prospective self; however, no research has been conducted looking at the influence of prospective self on substance use trajectories specifically.

Hypotheses

The overall goal of this study was to understand the relationship between internalizing behavior problems, externalizing behavior problems, and prospective self on alcohol and marijuana use occurrences in the past year for adolescents.

Alcohol. We hypothesized that externalizing behavior problems and alcohol use occurrences would have a positive relationship, whereas higher levels of externalizing behavior problems would be associated with more alcohol use occurrences. We also hypothesized that prospective self would serve as a significant protective factor, whereas a higher prospective self would significantly contribute to less alcohol use occurrences. As adolescents often use alcohol in more social environments, we hypothesized that internalizing behavior problems would not be significantly associated with alcohol use occurrences.

We also explored an interaction effect between externalizing behavior problems and prospective self as a predictor, to test whether higher levels of prospective self served as a protective factor in lower alcohol use occurrences for adolescents with higher scores on externalizing behavior problems. We are not aware of other studies that have explored interaction effects, and thus we do not propose a directional hypothesis.

Marijuana. We hypothesized that higher levels of externalizing and internalizing behavior problems would be associated with more marijuana use occurrences among adolescents. We also hypothesized that prospective self would serve as a protective factor, whereas at higher levels of prospective self, marijuana occurrences would be lower.

Since we predicted externalizing and internalizing behavior problems to affect marijuana use occurrences, we explored whether the interactions between internalizing behavior problems and prospective self and externalizing behavior problems and prospective self, would be significant predictors of marijuana use. We are not aware of other studies that have explored interaction effects, and thus we do not propose a directional hypothesis.

Methods

Participants

We used data provided by the Adolescent Health Risk Behavior (AHRB) project. The AHRB project collected data in schools from 10th–12th graders ($N = 2017$) at Wave 1, followed by two additional waves, beginning at ages 15–17, with the last wave at ages 21–23, focusing on adolescent risk health behavior. The adolescents were recruited from nine public school districts across eight Southeastern Michigan counties using a quota sampling design to approximate the statewide population diversity.

Table 1

Demographic characteristics of study sample (N=2017)

Demographic Information

Age, M (SD)	16.8 (1.1)
Sex, n (%) female	1110 (55.0)
Race, n (%)	
American Indian/Alaska Native	11 (.5)
Asian	56 (2.8)
Black or African American	465 (23.1)
White	1150 (57.0)
Native Hawaiian or Other Pacific Islander	3 (.1)
More than one race	253 (12.5)
Not Identified by Respondent	79 (3.9%)
Ethnicity, n (%)	
Non-Hispanic or Latino	1851 (91.8)
Hispanic or Latino	161 (8.0)
Unidentified or Not Reported	5 (.2)
Current level of education, n (%)	
10th grade	985 (48.8)
12th grade	1032 (51.2)
Mother's Education, n (%)	
Completed less than grade school	21 (1.0)
Some high school	154 (7.6)
Completed high school	388 (19.2)
Some college	429 (21.3)
Completing college	608 (30.1)
Graduate or professional school after college	325 (16.1)

Missing 92 (4.6)

Data

We will use substance use data collected during Wave 1 to examine participants' alcohol and marijuana use frequencies in relation to externalizing and externalizing behavior problems and prospective self.

First-wave data were collected between mid-March 2015 and mid-February 2016. The variables of internalizing and externalizing behavior problems, prospective self, and alcohol and marijuana use were measured through self-report survey questionnaires.

Internalizing and Externalizing Behavior Problems

Internalizing and externalizing behavior problems were measured using the ASEBA Youth Self-Report (YSR) survey (Achenbach, 2013). The YSR Survey is comprised of 112 questions for youth (11–18 years old) that aims to assess the youths' internalizing and externalizing behaviors (Achenbach & Rescorla, 2001). Questions are answered by choosing one of the three options to the statements: (1) Not true, (1) Somewhat or Sometimes True, and (2) Very true or Often True. The total scores are added up, and higher scores indicate behavior problems on that scale. The AHRB version uses a shortened form (96 items) from the problem section, including externalizing and internalizing scales.

The YSR includes two broad scales: internalizing and externalizing problems. Internalizing problems include being withdrawn/depressed while externalizing problems include attentional/deficit/hyperactivity problems and oppositional defiant problems.

Table 2
AHRB Descriptives

externalizing

Internal

Sample	∞	M (SD)	∞	M (SD)
Wave 1 Total Sample	.893	50.80 (10.46)	.906	53.19 (11.48)

Note. Externalizing indicates Externalizing Problems, internalizing indicates Internalizing Problems, and total indicates YSR total score for all subcategories. Alpha (∞) indicates the internalizing reliability of each scale in the AHRB cohort.

The internalizing and externalizing behavior problem scores were both re-coded on a scale from 0–2, where 0 means within the normal range, 1 means borderline clinical significance, and 2 indicates a potential for clinical significance.

Prospective Self

Prospective self was measured by Zinn et al. (2020) by looking at three constructs: future orientation, academic aspiration, and peer influence. The measures were factor-analyzed using exploratory and then confirmatory factor analysis. We used the participant's prospective self factor score derived from those factor analyses. Prospective self was scored by Zinn et al. (2020) on a standardized continuous scale between -1 and 1, where scores below 0 represent below average prospective self, a score of 0 represents the average prospective self, and scores above 0 represent the above-average prospective self.

Substance Use

Alcohol and marijuana use data was collected during the in-school session for Wave 1. Participants were asked questions about 15 risk behaviors, including a number of substance use categories. The data used here were in response to questions about their use of alcohol and marijuana in the past 12 months. For alcohol and marijuana, the categories were coded as the following: (1) 0 = 0 occasions, (2) 1 = 1–2 occasions, (3) 2 = 3–5 occasions, (4) 3 = 6–9 occasions, (5) 4 = 10–19 occasions, (6) 5 = 20–39 occasions, and (7) 6 = 40+ occasions.

Data Analysis

A linear regression analysis was selected to establish the relationship between our independent variables – internalizing behavior problems, externalizing behavior problems, and prospective self – and our dependent variables – frequency of problematic alcohol or marijuana use. Two linear regressions were run. In the first linear regression, the dependent variable was the frequency of alcohol use. In the second linear regression, the dependent variable was the frequency of marijuana use.

Using SPSS, two linear regression analyses were performed. One key factor in conducting linear regressions was for all the variables to be continuous. Alcohol and marijuana use problems are technically categorical variables, but their values are based on a numerical indicator (occurrences). Prospective self was also continuous. Now that our independent variables—internalizing and externalizing behavior problems and prospective self—and dependent variables—alcohol and marijuana use occurrences—were continuous, we ran our first model for both alcohol and marijuana.

Our second model included a number of covariates that may have contributed to alcohol and/or marijuana use. The variables we included in the second model were: (1) race (not reported by participant, African Indian/Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, and more than one race), with White being the reference category, (2) ethnicity (Hispanic or Latino and unidentified or not specified) with the reference category being not Hispanic or Latino, (3) sex (male) and female as the reference category, (4) grade (12th grade) with 10th grader being the reference category, and (5) mother's education (completed grade school or less, some high school, completed high school, some college, and graduate or professional school) with completed college as the reference category. The reference categories were selected by the category with the highest number of participants.

For race, ethnicity, and mother's education, since there were more than two categories, dummy variables were created so that SPSS could analyze each category. A dummy variable was created for every category except the reference category. Once all of the dummy variables were coded, we ran a univariate model for both alcohol and marijuana. In the univariate models, we included all of our independent variables and all the dummy variables.

Finally, a final model for both alcohol and marijuana frequency use was conducted to see whether the interactions between our independent variables were statistically significant. The interactions that we were interested in looking at were (1) prospective self*internalizing behavior problems and (2) prospective self*externalizing behavior problems. While looking at the interaction effects, we also kept the covariate variables. The test we ran for model 3 was a univariate analysis.

Results

Preliminary Results

Table 1

Table 1 represents the demographics of our 2017 participants. The mean age for the participants was 16.8 years old, and 55.0% ($n=1110$) of the participants were female. Of all our participants, 57.0% ($n=1150$) were White, 23.1% ($n=465$) were Black or African American, 2.8% ($n=56$) were Asian, 0.5% ($n=11$) were American Indian/Alaska Native, 0.1% ($n=3$), 12.5% ($n=253$) were more than one race, and 3.9% ($n=79$) did not identify their race. For ethnicity, 91.8% ($n=1851$) were non-Hispanic or Latino, 8.0% ($n=161$) were Hispanic or Latino, and 0.2% ($n=5$) were unidentified or not reported.

For participant education level, 48.8% ($n=985$) were in 10th grade, while 51.2% ($n=1032$) were in 12th grade. Of all our participants, 30.1% ($n=608$) had a mother who

completed college, 21.3% ($n=429$) had a mother who completed some college, 19.2% ($n=388$) had a mother who completed high school, 16.1% ($n=325$) had a mother who completed graduate or professional school after college, 7.6% ($n=154$) had a mother who completed some high school, 1% ($n=21$) had a mother who completed than grade school, and 4.6% ($n=92$) participant responses were missed.

Table 2

The second table depicts the overall internalizing and externalizing problem scores for all participants. For externalizing problems, the mean was 50.80 ($SD=10.46$), while for internalizing problems, the mean was 53.19 ($SD=11.48$). Both tests for internalizing ($\alpha=.893$) and externalizing ($\alpha=.906$) were reliable. The YSR uses T-scores, with a population mean of 50, and a standard deviation of 10. The levels for this sample are thus similar to the population distribution.

Predictors	Model 1				Model 2				Model 3			
	<i>b</i>	95% CI		<i>p</i>	<i>b</i>	95% CI		<i>p</i>	<i>b</i>	95% CI		<i>p</i>
Intercept	1.012	0.934	1.090	<.001**	1.549	1.391	1.708	<.001**	1.546	1.387	1.705	<.001**
Externalizing Behavior Problem	0.916	0.747	1.084	<.001**	0.849	0.685	1.013	<.001**	0.885	0.693	1.078	<.001**
Internalizing Behavior Problem	−0.079	−0.198	0.039	0.188	−0.087	−0.202	0.029	0.140	−0.084	−0.200	0.032	0.158
Prospective Self	−0.438	−0.810	−0.066	0.021*	−0.587	−0.953	−0.222	0.002**	−0.660	−1.065	−0.255	0.001**
Race; (ref= white)												
Not Identified by Respondent					−0.782	−1.289	−0.276	0.002**	−0.779	−1.286	−0.273	0.003**
American Indian/Alaska Native					0.234	−0.617	1.085	0.590	0.241	−0.612	1.093	0.579
Asian					−0.539	−0.944	−0.135	0.009**	−0.538	−0.943	−0.134	0.009**
Black or African American					−0.501	−0.678	−0.323	<.001**	−0.503	−0.680	−0.325	<.001**
Native Hawaiian or Other Pacific Islander					1.286	−0.607	3.179	0.183	1.303	−0.596	3.202	0.179
More than one race					−0.217	−0.431	−0.004	0.046*	−0.222	−0.437	−0.008	0.042*
Ethnicity (ref=not Hispanic or Latino)												

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Hispanic or Latino	0.148	-0.157	0.453	0.343	0.149	-0.156	0.454	0.339
Sex (ref= female)								
Male	0.186	0.047	0.324	0.009**	0.192	0.052	0.331	0.007**
Subject Grade (ref= 10th Grade)								
12th Grade	-0.822	-0.959	-0.686	<.001**	-0.819	-0.955	-0.682	<.001**
Mother's education (ref= completed college)								
Completed grade school or less	0.026	0.939	-0.653	0.706	0.019	-0.662	0.699	0.957
Some high school	-0.083	0.561	-0.362	0.196	-0.084	-0.363	0.195	0.557
Completed high school	-0.101	0.310	-0.296	0.094	-0.102	-0.297	0.093	0.306
Some college	-0.155	0.102	-0.342	0.031*	-0.156	-0.343	0.030	0.100
Graduate or professional School after college	-0.184	0.073	-0.385	0.017*	-0.185	-0.387	0.016	0.071
Externalizing Behavior *								
Prospective Self					0.207	-0.547	0.961	0.590
Internalizing Behavior *								
Prospective Self					0.101	-0.467	0.668	0.728

NOTE: ref = reference category

*p≤.05

**p≤.01

Alcohol

Model 1. In model 1, externalizing behavior problems ($B=0.916$, 95% CI =0.747–1.084, $p<.001$) and prospective self ($B= -0.438$, 95% CI = –0.810– –0.066, $p=0.021$) were statistically significant. The externalizing behavior significance indicated a significantly higher level of alcohol use occurrences when there is a one–unit higher level of externalizing behavior problems, internalizing behavior problems, and prospective self remains consistent. For prospective self, the results indicate a significantly lower level of alcohol use occurrences when there is a one–unit higher level of prospective self, and internalizing and externalizing behavior problems remain constant. Internalizing behavior problems were not significant predictors of alcohol use occurrences in the past 12 months.

Model 2. In model 2, externalizing behavior problems ($B=0.849$, 95% CI =0.685–1.013, $p<.001$) and prospective self ($B= -0.587$, 95% CI = –0.953– –0.222, $p=0.002$) remained statistically significant after the inclusion of key participant demographic characteristics. The externalizing behavior significance remains consistent and indicates a significantly higher level of alcohol use occurrences when there is a one–unit higher level in externalizing behavior problems, internalizing behavior problems, and prospective self. For prospective self, the results remained constant and indicated a significantly lower level of alcohol use occurrences when there is a higher level one unit of prospective self and internalizing and externalizing behavior problems. As in model 1, internalizing behavior problems were not significant predictors of alcohol use occurrences in the past 12 months.

The covariate variables that are statistically significant in this model are the following:

- (1) Not identified by the respondent ($B= -0.782$, 95% CI = –1.289– –0.276, $p=.002$), (2) Asian ($B= -0.539$, 95% CI = –0.994– –0.135, $p=.009$), (3) Black or African American ($B= -0.501$, 95%

CI = -0.678 – -0.323 , $p < .001$), (4) More than one race ($B = -0.217$, 95% CI = -0.431 – -0.004 , $p = .046$), (4) Male ($B = 0.186$, 95% CI = 0.047 – 0.324 , $p = .009$), (5) 12th Grade ($B = -0.882$, 95% CI = -0.959 – -0.686 , $p < .001$), (6) Mother having done some college ($B = -0.155$, 95% CI = 0.102 – -0.342 , $p = .031$), and (7) mother having completed graduate school or another professional school ($B = -0.184$, 95% CI = 0.073 – -0.385 , $p = .017$).

For race, the reference category was White. Compared to White participants, Asian participants, Black and African American Participants, participants with more than one race, and participants who did not identify their race indicated significantly lower levels of alcohol use occurrences in the past 12 months, with all other variables statistically controlled.

Moreover, compared to females, males indicated a significantly higher level of alcohol use occurrences, while all other variables remained constant. Also, compared to 10th graders, 12th graders indicated a significantly lower level of alcohol use occurrences while all other variables remained constant.

Finally, levels of mothers' education were compared to participants whose mothers completed college. Therefore, participants with a mother who completed graduate school or a professional school after college indicated significantly lower levels of alcohol use occurrences in the past 12 months, as all other variables remained constant.

Model 3. Lastly, in model 3, externalizing behavior problems ($B = 0.885$, 95% CI = 0.693 – 1.078 , $p < .001$) and prospective self ($B = -0.660$, 95% CI = -1.065 – -0.255 , $p = 0.001$) remained statistically significant predictors. As in models 1 and 2, the externalizing behavior significance remains consistent and indicates a significantly higher level of alcohol use occurrences when there is a one-unit higher level for externalizing behavior problems, internalizing behavior problems, and prospective self remain constant. For prospective self, the

results remain consistent and indicate a significantly lower level of alcohol use occurrences when there is a one-unit higher level of prospective self, and internalizing and externalizing behavior problems remain constant. Internalizing behavior problems were not significant predictors of alcohol use occurrences in the past 12 months.

The covariate variables that are statistically significant in this model are the following:

(1) Not identified by the respondent ($B = -0.779$, 95% CI = -1.286 – -0.273 , $p = .003$), (2) Asian ($B = -0.538$, 95% CI = -0.943 – -0.134 , $p = .009$), (3) Black or African American ($B = -0.503$, 95% CI = -0.680 – -0.325 , $p < .001$), (4) More than one race ($B = -0.222$, 95% CI = -0.437 – -0.008 , $p = .042$), (4) Male ($B = 0.192$, 95% CI = 0.052 – 0.331 , $p = .007$), and (5) 12th Grade ($B = -0.819$, 95% CI = -0.955 – -0.682 , $p < .001$).

For race, the reference category was White. Similarly, compared to White participants, Asian participants, Black and African American Participants, and participants with more than one race showed significantly lower levels of alcohol use occurrences in the past 12 months as all other variables remained constant.

Moreover, compared to females, males indicated a significantly higher level of alcohol use occurrences, while all other variables remained constant. Also, compared to 10th graders, 12th graders indicated a significantly lower level of alcohol use occurrences while all other variables remained constant.

None of the interaction effects were statistically significant.

Table 4

Parameter Estimates for Marijuana Use Occurrences in the Past 12 Months

Predictors	Model 1				Model 2				Model 3			
	<i>b</i>	95% CI		<i>p</i>	<i>b</i>	95% CI		<i>p</i>	<i>b</i>	95% CI		<i>p</i>
Intercept	0.673	0.583	0.762	<.001**	1.018	0.828	1.208	<.001**	1.008	0.818	1.198	<.001**
Externalizing Behavior Problem	1.338	1.129	1.547	<.001**	1.258	1.048	1.468	<.001**	1.243	0.992	1.494	<.001**
Internalizing Behavior Problem	-0.150	-0.289	-0.012	0.034*	-0.141	-0.281	-0.001	0.048*	-0.128	-0.268	0.012	0.073
Prospective Self	-0.800	-1.233	-0.367	<.001**	-0.852	-1.292	-0.412	<.001**	-1.016	-1.500	-0.532	<.001**
Race; (ref= white)												
Not identified by respondent					-0.460	-1.065	0.146	0.137	-0.469	-1.075	0.136	0.129
American Indian/Alaska Native					-0.303	-1.335	0.729	0.565	-0.266	-1.299	0.767	0.614
Asian					-0.591	-1.058	-0.125	0.013*	-0.604	-1.070	-0.138	0.011*
Black or African American					-0.176	-0.392	0.040	0.111	-0.175	-0.391	0.040	0.111
Native Hawaiian or Other Pacific Islander					-0.168	-3.234	2.898	0.915	-0.166	-3.229	2.898	0.915
More than one race					0.236	-0.025	0.496	0.076	0.216	-0.044	0.477	0.104
Ethnicity (ref=not Hispanic or Latino)												
Hispanic or Latino					0.370	0.001	0.739	0.049*	0.393	0.024	0.762	0.037*

Sex (ref= female)

Male

-0.152 -0.317 0.013 0.071

-0.136 -0.302 0.030 0.109

Subject Grade (ref= 10th
Grade)

12th Grade

-0.596 -0.759 -0.433 <.001*

-0.589 -0.752 -0.426 <.001*

Mother's education (ref=
completed college)Completed grade
school or less

0.019 -0.832 0.870 0.965

0.025 -0.826 0.875 0.955

Some high school

0.380 0.046 0.713 0.026*

0.386 0.052 0.719 0.023*

Completed high
school

0.144 -0.091 0.379 0.230

0.141 -0.093 0.376 0.237

Some college

0.022 -0.201 0.244 0.849

0.019 -0.204 0.241 0.869

Graduate or
professional School
after college

-0.020 -0.258 0.219 0.870

-0.019 -0.258 0.219 0.873

Externalizing Behavior
* Prospective Self

-0.458 -1.432 0.515 0.356

Internalizing Behavior *
Prospective Self

0.752 0.065 1.439 0.032*

NOTE: ref = reference category

*p≤.05

**p≤.01

Marijuana

Model 1. In model 1, externalizing behavior problems were statistically significant ($B=1.338$, 95% CI = 1.129–1.547, $p<.001$), indicating a higher level in marijuana use occurrences when internalizing behavior problems and prospective self remain constant. Internalizing behavior problems were statistically significant ($B= -0.150$, 95% CI = -0.289 – -0.012 , $p=.034$), indicating a lower level in marijuana use occurrences when externalizing behavior problems and prospective self remains constant. Finally, prospective self was also statistically significant ($B= -0.800$ 95% CI = -1.233 – -0.367 , $p<.001$), indicating a lower level in marijuana use occurrences as externalizing and internalizing behavior problems remain constant.

Model 2. In model 2, externalizing behavior problems remained statistically significant ($B=1.258$, 95% CI = 1.048–1.468, $p<.001$), indicating a significantly higher level of marijuana use occurrences in the past 12 months when internalizing behavior problems and prospective self remains constant and after controlling for key participant demographic covariates. Internalizing behavior problems remain statistically significant ($B= -0.141$, 95% CI = -0.281 – -0.001 , $p=.048$), indicating a significantly lower level of marijuana use occurrences when externalizing behavior problems and prospective self remains constant. Finally, prospective self also remained statistically significant ($B= -0.852$ 95% CI = -1.292 – -0.412 , $p<.001$), indicating a significantly lower level in marijuana use occurrences as externalizing and internalizing behavior problems remained constant.

The covariate variables that were statistically significant in this model are the following: (1) Hispanic or Latino ($B=0.370$, 95% CI = 0.001–0.739, $p=0.049$), (2) 12th grade ($B= -0.596$, 95% CI = -0.759 – -0.433 , $p<.001$), and (3) mother who completed high school ($B=0.380$, 95% CI = 0.046–0.713, $p=.026$). For ethnicity, the reference category was Not Hispanic or Latino.

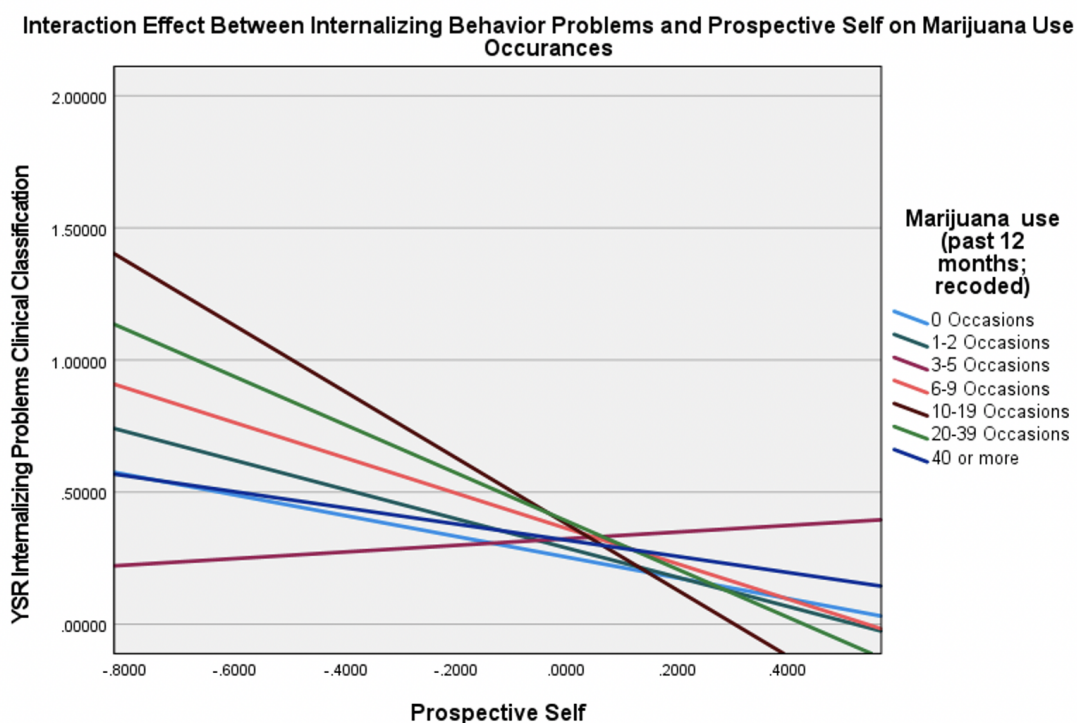
Accordingly, compared to participants that are not Hispanic or Latino, participants who are Hispanic or Latino seem to indicate a significantly higher level of marijuana use occurrences, as all other variables remained constant. For sex, the reference category was female, which means that compared to females, males indicated a significantly lower level of marijuana frequency occurrences. For age, the reference category was 10th grade, which means that compared to 10th graders, 12th graders indicated a significantly lower level of marijuana frequency occurrences. Finally, for the mother's education variable, the reference category was that the mother had completed college. Therefore, compared to participants who have a mother that completed college, those with a mother who completed high school indicate a significantly lower level of marijuana use occurrences in the past 12 months, as all other variables remained constant.

Model 3. In model 3, with the inclusion of two interaction terms, externalizing behavior problems remained statistically significant ($B=1.242$, 95% CI = 0.992–1.494, $p<.001$), indicating a significantly higher level of marijuana use occurrences in the past 12 months when internalizing behavior problems and prospective self remain constant. Prospective self was also statistically significant ($B= -1.016$ 95% CI = -1.500 – -0.532 , $p<.001$), indicating a significantly lower level of marijuana use occurrences as externalizing and internalizing behavior problems remained constant. Internalizing behavior problems were no longer statistically significant.

The covariate variables that are statistically significant in this model are the following: (1) Asian ($B= -0.604$, 95% CI = -1.070 – -0.138 , $p=0.011$), (2) Hispanic or Latino ($B=0.393$, 95% CI = 0.024 – 0.762 , $p=0.037$), (3) 12th grade ($B= -0.589$, 95% CI = -0.752 – -0.426 , $p<.001$), and (4) mother who completed high school ($B=0.386$, 95% CI = 0.052 – 0.719 , $p=.023$). For race, the reference category was White participants, which means that compared to White participants, Asian participants indicated a significantly lower level of marijuana use occurrences in the past

12 months, as all other variables remained constant. For ethnicity, the reference category was Not Hispanic or Latino. Accordingly, compared to participants that are not Hispanic or Latino, participants who are Hispanic or Latino seem to indicate a significantly higher level of marijuana use occurrences, as all other variables remained constant. For grade, the reference category was 12th graders, which means that compared to 10th graders, 12th graders indicated a significantly lower level of marijuana use occurrences in the past 12 months. Finally, for the mother's education variable, the reference category was that the mother had completed college. Therefore, compared to participants who have a mother that completed college, those with a mother who completed high school indicate a significantly higher level of marijuana use occurrences in the past 12 months, as all other variables remained constant.

Figure 1: Plot of Interaction Effect Between Internalizing Behavior Problems and Prospective Self on Marijuana Use



The interaction effects included in the model were prospective self*internalizing behavior problems and prospective self*externalizing behavior problems. Only the interaction between prospective self*internalizing behavior problems ($B=0.752$, 95% CI = 0.065–1.429, $p=.032$) was statistically significant. This indicates that the interaction of higher internalizing and higher prospective self was associated with higher marijuana use.

Discussion

Our study aimed to examine the effects of internalizing and externalizing behavior problems and prospective self on adolescent alcohol and marijuana use occurrences in the past 12 months. To further understand the effects of internalizing and externalizing behavior problems and prospective self, we also evaluated the relationship between race, ethnicity, sex, school age, and mother's education. Finally, we also assessed the effects of the interaction effects between internalizing problems and prospective self and externalizing problems and prospective self to understand the relationship among our independent variables and their effects on alcohol and marijuana use occurrences.

Alcohol

The results of our linear analysis for alcohol use occurrences only partly supported our hypotheses. As hypothesized, externalizing behavior problems had a significant positive relationship with alcohol use occurrences. Moreover, our results support our hypothesis that internalizing behavior problems are not significantly associated with alcohol use problems. Similarly, we also hypothesized that alcohol use occurrences and prospective self would have a significant negative relationship. Our results support our hypothesized relationship between alcohol use occurrences and prospective self. However, we also hypothesized that there would be

a significant interaction effect between externalizing behavior problems and prospective self, but the results did not support this hypothesis.

Externalizing Behavior Problems

Our results regarding the positive relationship between a higher level of externalizing behavior problems and a higher level of alcohol use occasions are consistent with other research findings, as much research suggests a strong relationship between externalizing behavior problems and alcohol use (Fite et al., 2006; Helstrom et al., 2004; Stice & Barrera, 1995). According to Fite et al. (2005), this relationship can be due to the association between increased externalizing behavior problems and increased socialization with delinquent peers; with an increase in socialization with delinquent peers, there is likely an increase in alcohol use.

Internalizing Behavior Problems

Our results found no statistically significant relationship between alcohol use occasions and internalizing behavior problems, but the results follow the direction that much research has found (Edwards et al., 2014; Fite et al., 2006; Stice & Barrera, 1995). Our results suggest a negative relationship between internalizing behavior problems and alcohol use occasions, which means that as there with a higher level of internalizing behavior problems, there is a lower level of alcohol use occasions. Given the association between socialization and alcohol use, research suggests that internalizing behavior problem serves as a protective factor against delinquent peer association and, therefore, early alcohol use (Edwards et al., 2014; Fite et al., 2006) In particular, internalizing behavior problems could lead to difficulty interacting with peers early on, which in turn, is associated with less alcohol use early on as early alcohol use is associated with peer interaction (Edwards et al., 2014).

Interestingly, Stice and Barrera's (1995) research found a relationship between internalizing behavior problems and drugs but did not find it with alcohol. According to their results, Stice and Barrera (1995) suggest that unlike drugs which are illegal at all times and for all ages, alcohol eventually becomes legal within age, which potentially means that internalizing behavior problems serve more as a preventative factor for drugs.

Marijuana

The results of our linear analysis for alcohol use occurrences mainly supported our hypotheses as externalizing and internalizing behavior problems and prospective self all had a significant effect on marijuana use occurrences for the participants in the past 12 months. However, when we included the interaction effects in the third model, internalizing behavior problems were no longer significant. For the interaction effects, only the interaction between internalizing behavior problems and prospective self was statistically significant. We hypothesized that the interaction between externalizing behavior problems and prospective self would be significant, but the results did not support this hypothesis.

Externalizing Behavior Problems

Similar to alcohol use, our findings regarding the positive relationship between a higher level of externalizing behavior problems and a higher level of marijuana use occasions are consistent with some research (Griffith–Lendering et al., 2011; Hayatbakhsh et al., 2008; Steele et al., 1995; Wasserman et al., 2021). However, other research has suggested that while externalizing behavior problems relate to marijuana use, other factors are also powerful predictors of marijuana use (Korhonen et al., 2010). For example, according to Korhonen et al. (2010), early-onset smoking is associated with cannabis use.

Internalizing Behavior Problems

With the exception of the third model, the negative relationship between internalizing behavior problems was significant. The relationship we found is inconsistent with some research (Griffith–Lendering et al., 2011; Steele et al., 1995; Wasserman et al., 2021). For example, according to Steele et al. (2011), greater internalizing behavior problems are associated with less marijuana use in young adulthood. Similarly, Griffith–Lendering et al. (2008) found no association between internalizing behavior problems and marijuana use in early adolescence.

Interestingly, according to Wasserman et al. (2021), both internalizing and externalizing behavior problems are associated with marijuana use, but each does so through its unique processes. Essentially, adolescents who exhibit more aggressive and delinquent behaviors tend to follow the externalizing behavior pathway to marijuana use, while adolescents who exhibit negative affect and depressive symptoms tend to follow the internalizing behavior pathway to marijuana use (Wasserman et al., 2021).

Prospective Self

Our results indicate that prospective self serves as a protective factor against alcohol and marijuana use, as a higher level of prospective self leads to a lower level of alcohol and marijuana use occasions. Given that prospective self was coined by Zinn et al. (2020) recently, only their paper looks at prospective self. Their study suggests that prospective self serves as a protective factor against externalizing behavior problems (Zinn et al., 2020). Since our results suggest that a higher level of externalizing behavior problems leads to a higher level of alcohol and marijuana use occasions, it makes sense that prospective self is associated with a lower level of alcohol and marijuana use occasions as it works against externalizing behavior problems.

Prospective self is composed of future orientation, academic aspiration, and resistance to peer influence. While prospective self is a new term, research demonstrates that future

orientation, academic aspiration, and resistance to peer influence individually work as protective factors against substance use. For example, adolescents with positive future orientation were less likely to engage in risky behaviors, such as alcohol during sex, and marijuana, drug, and alcohol use were less likely to experience alcohol problems (Jackman & MacPhee, 2016; Robbins & Bryan, 2004). On the contrary, less positive future orientation was significantly associated with alcohol during sex, more alcohol problems, and increased substance use (Jackman & MacPhee, 2016).

Moreover, research has shown consistent results that compared to adolescent substance users; nonusers tend to have higher academic aspirations (Paulson et al., 1990). It is also important to note, however, that there is a bidirectional relationship between academic motivation and aspiration and substance use. On the one hand, the lower one's academic motivation and aspiration are, the more likely they are to use substances. On the other hand, the more an adolescent uses substances, the more likely their academic motivation and aspiration will decrease (Andrews et al., 1991).

Finally, peer influence is important to consider when thinking about adolescent substance use because peers have an influence on whether or not one uses substances (Bauman & Ennett, 1996; Kandel, 1985). While parents and peers both play influential roles in the decisions that adolescents make, parents tend to have more influence on their child's plans for the future, while peers have a greater influence on whether the adolescent will use substances or not (Kandel, 1985; Schuler et al., 2019).

Implications

The findings from the present study have implications for the prevention and treatment of alcohol and marijuana use.

Prevention

Given that there is a significant relationship between externalizing behavior problems and alcohol use occasions, focusing on youth who exhibit greater levels of externalizing behavior problems for the prevention of alcohol use can prove to be key. For marijuana prevention, having a prevention program for youth who display either internalizing behavior problems, externalizing behavior problems, or a combination could also be extremely beneficial. Much research suggests that internalizing and externalizing behavior problems play a role in the developmental pathways to substance use (Colder et al., 2012; Colder et al., 2017; Couwenbergh et al., 2006; Hussong et al., 2011; Miettunen et al., 2013). There is some research that explores family prevention treatments for at-risk youth that seem to have effective results, but more research should be conducted to better understand the incorporation of externalizing and internalizing behavior problem prevention methods into at-risk substance use prevention programs (Dishion & Andrews, 1995).

Moreover, prospective self functions as a significant protective factor, which suggests that prevention programs that focus on strengthening an adolescent's future orientation, resistance to peer influence, and academic aspirations can also serve as a significant prevention focus for alcohol and marijuana use. Given that there are no studies about prospective self in prevention programs, future research should learn about or incorporate prospective self into risk behavior prevention programs.

While there are no studies on the use of prospective self in prevention programs, a study conducted by Stoddard et al. (2020) demonstrates that the incorporation of future orientation and psychological empowerment—confidence, skills, and behavioral strategies to achieve

self-identified future goals—into a 5-week in-school prevention program for 6th and 7th graders can support future prevention of substance use.

Treatment

Like with prevention programs, our results can also provide avenues for potential adolescent alcohol and marijuana treatment programs. Given that there is a significant relationship between externalizing behavior problems and alcohol use occasions, incorporating a treatment program that focuses on decreasing externalizing behavior problems can have an effect on decreasing alcohol use. For marijuana, having a treatment program that focuses on decreasing one's internalizing and/or externalizing behavior problems can also have an effect on decreasing one's marijuana use.

In considering our results, screening adolescents for internalizing and externalizing behaviors before initiating substance use treatment can be beneficial in providing adolescents with additional resources that could support them throughout their treatment journey. Co-occurring mental health problems—both internalizing and externalizing behavior problems—and substance use are highly prevalent among youth (Chan et al., 2008). These findings are significant because they suggest that screening for and incorporating or adding treatment for a co-occurring disorder can positively influence substance use treatment programs.

A treatment that has been popular and resembles the inclusion of externalizing behavior problems is Multidimensional Family Therapy (MDFT). MDFT is a treatment program that focuses on adolescent substance misuse and delinquency with the aim of treating adolescent substance use and appears to demonstrate significant changes in substance use (Austin et al., 2005; Liddle et al., 2004; Liddle et al., 2006). While family therapy focuses on delinquency as well, there isn't research that looks directly at the effects of screening for externalizing and

internalizing behavior problems on adolescents for substance use treatment and providing tailored treatment or resources for those who exhibit those behaviors for substance use treatment. Future research should explore incorporating externalizing and externalizing behavior treatment resources and programs with substance use treatment for adolescents.

Moreover, since prospective self functions as a significant protective factor, incorporating programs that strengthen one's prospective self can strengthen the effect of prospective self on serving as a protective factor for alcohol and marijuana use. Future research should explore the effects of incorporating prospective self into substance use treatment programs.

Future Research

Our results open a new avenue for research where to better understand the internalizing and externalizing pathways to alcohol and marijuana use and the influence of prospective self in protecting against alcohol and marijuana use.

For one, this study helps us understand the relationship between internalizing and externalizing behavior problems with alcohol and marijuana use occurrences, but it does not allow us to understand how the relationships work. Future research should learn more about the “how” and “why” of pathways toward alcohol and marijuana use. Presently, research focusing on the influence of internalizing and externalizing behavior problems on socialization and its relationship to alcohol and marijuana use falls within this realm. To further this type of research, it would be interesting to understand how internalizing and externalizing behavior problems influence academic success or affiliations with extracurriculars, for example, and how that influences alcohol and marijuana use.

Finally, since prospective self is a new latent construct, future research should study it more and its relation to adolescent substance use. From Zinn et al. (2020), it appears that

prospective self plays a role in supporting resilience against externalizing problems. In our study, it seems that prospective self can serve as a protective factor against having a higher level of alcohol and marijuana use occasions. Clearly, prospective self seems to be a significant protective factor for adolescents. Therefore, future research should further research what prospective self is a protective factor for, and once those relationships are established, research should help better understand how prospective self is a protective factor and how it can be incorporated into prevention and treatment programs.

Limitations and Strengths

Limitations

As with all studies, there are limitations worth noting. First, alcohol and marijuana use in our sample was relatively low. Around half the participants reported either “0 occasions” or “1–2” occasions, which provides a skewed distribution and, therefore, results may not be as generalizable to youth with higher levels of alcohol and marijuana use. Given this limitation, these results might be more applicable to adolescents who report lower levels of alcohol and marijuana use.

There may also be limitations related to the use of alcohol and marijuana use occasions in the past 12 months as our outcome. Since a year is a long time, adolescents might have underreported the number of alcohol and marijuana use occasions as they may not remember all the times they have used, and the measure may have resulted in an underreporting of alcohol and marijuana use in our sample.

One additional limitation is the possibility of method covariance between the YSR externalizing scale, which includes a few items regarding substance use, and the prevalence measures of alcohol and marijuana use.

Finally, the results noted that compared to 10th graders, 12th graders seemed to have had fewer alcohol and marijuana use occurrences. According to NIH, a greater proportion of 12th graders use marijuana and alcohol than 10th graders (NIDA, 2022). An explanation for our findings is that we could be seeing fewer high-risk 12th graders than 10th graders. A potential reason for this difference is that when conducting studies with adolescents recruited in school settings, the sample may be missing adolescents at the highest risk, as these are also the adolescents who are more likely to not be in school on the day of the survey. For example, the dropout age for children in Michigan is 16–17 years old, which means that those with the highest risk might have dropped out by 12th grade, so they were not represented in the survey, which was taken at school.

Strengths

Despite our limitations, the present study has several strengths. First, we had a large sample size ($n=2017$). A larger sample size is important because it allows for a more precise estimate of the relationships between internalizing and externalizing behavior problems and prospective self with alcohol and marijuana use occasions. Moreover, a larger sample size is important in reducing bias and increasing generalizability.

Additionally, our study sampled adolescents from nine public schools across Southeastern Michigan counties. First, this is a strength because, through the use of direct quota sampling design, we could approximate the statewide population diversity and therefore improve generalizability. Second, since we sample adolescents from across schools instead of sampling a population that falls under a specific category, such as “problematic substance users,” we could generalize the results to a more general adolescent population.

Finally, another strength is that we used the Youth Self Report Survey to measure adolescent internalizing and externalizing behavior problem levels. Using this survey proves a strength because it is extremely reliable.

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