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The Association of Adolescent Internalizing and Externalizing Behavior Problems and Prospective Self with Alcohol and Marijuana Use

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Abstract: Adolescent alcohol and marijuana use pose significant developmental risks. This study examined internalizing and externalizing problems as risk factors and prospective self as a protective factor in relation to alcohol and marijuana use. Self-report data were collected from a diverse sample (N = 2017) of 15-17-year-olds using the Youth Self Report (YSR) for behavior issues and Prospective Self, a factor derived variable reflecting future orientation, resistance to peer influence, and academic aspirations. Participants reported on 15 health risk behaviors, including alcohol and marijuana use. Weighted linear regressions evaluated associations between risk and protective factors and substance use. Model 1 included sociodemographic covariates. Model 2 added risk and protective factors, and Model 3 included interactions of internalizing and externalizing behaviors with prospective self. Results indicated higher externalizing behavior was linked to increased alcohol and marijuana use, while higher prospective self and internalizing behavior were linked to reduced alcohol use. Higher prospective self was associated with less marijuana use. Interaction terms were largely non-significant, except for the interaction between prospective self and internalizing behavior, where higher internalizing problems and high prospective self were linked to increased marijuana use. Findings highlight the importance of prospective self, especially at clinically elevated levels of behavior problems, and suggest further exploration of the unexpected positive association between internalizing behavior and prospective self with marijuana use.

Keywords: adolescent; substance use; internalizing problems; externalizing problems

1. Introduction

Adolescent substance use is an ongoing concern nationwide. Although it is illegal for individuals to consume alcohol under 21 and marijuana use is either completely illegal or illegal under 21, 2.08 million (or 8.33%) adolescents (12–17-year-olds) reported using substances in the last month [1]. Alcohol is the most commonly used illicit substance among adolescents, with 1.19 million adolescents and 11.72 million young adults (18-25-year-olds) reporting binge drinking in the last month [1]. According to the National Center for Drug Abuse Statistics (NCDAS), around 43.7% of youth have tried marijuana in their lifetime and 35.2% of youth have used marijuana in the last year, and 43.7% of youth have tried marijuana in their lifetime [1].

Early and/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-

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term changes in brain development [2]. Negative consequences of adolescent marijuana use include difficulty thinking and problem-solving, problems with memory and learning, reduced coordination, difficulty maintaining attention, and problems with school and social life [3].

1.1. Externalizing and Internalizing Behavior Problems

Externalizing problems include mental disorders that are characterized by poor self-regulation and can include behaviors such as rule-breaking, aggression, impulsivity, and inattention [4]. Numerous studies have identified associations between externalizing behavior problems and substance use [5,6].

Internalizing problems include behavioral symptoms (e.g., avoidance, worry, withdrawal) and negative emotions (e.g., irritability, sadness) associated with anxiety, depression and somatization [7]. Findings on the role of internalizing behaviors on substance use are mixed. Some studies indicate internalizing problems may be a risk factor for substance use, hypothesizing that youth may use substances to self-medicate when coping with internalizing problems [8,9]. Other studies found that internalizing symptoms can play a protective role, as social withdrawal and fear of negative consequences can protect adolescents from engaging with deviant peers and substance use [10,11].

Research has focused on both internalizing and externalizing behavior problems and their relationship with substance use [8,11,12]. Most studies found externalizing problems to be the strongest predictor of substance use [8,11,12]. When controlling for externalizing symptoms, findings suggest that internalizing symptoms serve as a protective factor for substance use [11], such as alcohol [12], cigarette and marijuana use [8].

1.2. Prospective Self

Prospective self [13], is a factor-derived construct proposing that adolescents' behavioral decisions are influenced by how they identify their current and future selves. Having academic aspirations, exhibiting a resistance to peer influence, and being future-oriented are three concurrent factors of the adolescent self that guide goal-oriented behavior and positive decision-making. Prospective self is negatively associated with externalizing and internalizing problems and confers resilience in youth by moderating the effect of childhood adversity on externalizing problems [13]. In this study, we examine the association of prospective self with substance use specifically.

1.3. Current Study

The aim of this study was to characterize the relationships between internalizing problems, externalizing problems, and prospective self with adolescent alcohol and marijuana use in the past year.

1.3.1. Alcohol

We hypothesized that higher levels of externalizing behavior problems would be associated with more alcohol use occurrences. We also hypothesized that prospective self would serve as a protective factor, such that a higher level of prospective self would be associated with fewer alcohol use occurrences. As adolescents often use alcohol in more social environments due to having friends who use substances being the most robust predictor [16], we hypothesized that internalizing behavior problems would not be significantly associated with alcohol use occurrences.

We also explored the interaction of externalizing behavior problems and prospective self to evaluate whether prospective self moderated the effect of externalizing problems and alcohol use. We also tested the interaction of internalizing behavior problems and prospective self as a predictor of alcohol use. We are not aware of other studies that have explored these interaction effects, and thus, we do not propose a directional hypothesis.

1.3.2. Marijuana

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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 higher levels of prospective self would be associated with fewer marijuana use occurrences.

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

2. Materials and Methods

2.1. Participants

Study characteristics are briefly summarized here with additional details described in Supplementary Section 1. Participants are from the Adolescent Health Risk Behavior (AHRB) study. The AHRB project collected data in schools from 10th-12th graders (N = 2017, ages 15-17 years) at Wave 1 (March 2015 – February 2016) of a longitudinal study designed to characterize behavioral and cognitive correlates of risk behavior trajectories from mid-adolescence to emerging adulthood. The adolescents were recruited from nine public school districts across eight Southeastern Michigan counties. An accelerated cohort design using quota sampling was utilized to approximate the statewide population diversity. To address potential sampling bias, robust analyses using sampling weights derived from the American Community Survey (ACS; year 2015 to match Wave 1 of data collection) are discussed below.

2.2. Measures

We used substance use data collected during Wave 1 to examine participants' alcohol and marijuana use frequencies in relation to externalizing and externalizing behavior problems and to prospective self. The variables of internalizing and externalizing behavior problems, prospective self, and alcohol and marijuana use were measured through self-report survey questionnaires.

2.2.1. Internalizing and Externalizing Behavior Problems

Internalizing and externalizing behavior problems were measured using the ASEBA Youth Self-Report (YSR) survey [17]. The YSR Survey is comprised of 112 questions for youth (11-18 years old) that aim to assess the youths' internalizing and externalizing behaviors [18]. 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 internalizing and externalizing problem scores were both re-coded on a scale from 0-2, where 0 reflects total scores falling within nonclinical range, 1 indicating total scores falling within the borderline clinical range (T scores of 60 through 63, which indicate approximately the 84th – 90th percentile), and 2 indicates total scores falling within the clinical range (T scores ≥ 64 which indicate ≥ 91st percentile) [17]. We also report results using the continuous standardized T-scores in supplementary analyses (*see Supplementary Tables S4, S5*). Internalizing behavior problems (α = .89) and externalizing behavior problems (α =.91) exhibit high internal reliability.

2.2.2. Prospective Self

A factor derived score for prospective self comprised of scores on the Future Orientation scale [19], the Resistance to Peer Influence Scale [20], and a scale of academic aspirations. Factor analysis indicated a satisfactory fit (CFI = .98, RMSEA = .03, 90% CI RMSEA = .02 -.03, SRMR = .02). Prospective self scores were standardized (M = 0, SD = 1.

2.2.3. Substance Use

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Substance use items for self-reported 12-month alcohol use and 12-month marijuana use are drawn from and are identical to those used in annual, national Monitoring the Future surveys [21]. For Alcohol Use, participants responded to "On how many occasions (if any) have you had any alcoholic beverage to drink—more than just a few sips during the last 12 months?", using a seven-point Likert scale, 1 = "0 occasions" to 7 = "40 or more occasions". For Marijuana Use, participants responded to "On how many occasions (if any) have you used marijuana or hashish during the last 12 months?", using a seven-point Likert scale, 1 = "0 occasions" to 7 = "40 or more occasions"2.2.4. Sociodemographic covariates

Sociodemographic covariates, reported by each participant, include the participant's age in years, sex at birth, race, and grade in school. Participants also reported the level of education completed by each of their parents., which was used as a proxy for socioeconomic status (SES)., Responses options included: (1) grade school or less, (2) some high school, (3) completed high school, (4) some college, (5) completed college, (6) graduate or professional school, and (7) don't know or does not apply. Scores of both parents, if available, are averaged together, and for participants with a single parent, that parent's educational attainment is used with higher scores indicating more education (Bachman et al., 2011). [22,23].

2.3. Analyses

2.3.1. Descriptive Statistics and Correlations

Analyses were performed using STATA [24]. The descriptive statistics are reported to provide insight into the sociodemographic variables in these analyses. Data are reported as mean (standard deviation) or *n* (%). Bivariate associations are reported to describe the relationships in the sample.

2.3.2. Main Analyses

Nested linear regression analysis was utilized to evaluate the relationship between the hypothesized independent variables—internalizing problems, externalizing problems, and prospective self—and the substance use dependent variables, alcohol or marijuana use. Three nested models were run for each outcome. The first model included covariates that past research has suggested are related to alcohol and marijuana use [22]: (1) race (White non-Hispanic, Black or African non-Hispanic, Hispanic all races, more than one race non-Hispanic, and Other non-Hispanic), with white non-Hispanic as the reference category, (2) sex with female as the reference category, (3) grade with 10th grade as the reference category, (4) average parent education (completed grade school or less, some high school, completed high school, some college, completed college and graduate or professional school), with graduate or professional school being the reference category. The second model added our predictors – prospective self, internalizing behavior problems, externalizing behavior problems with the nonclinical range as the reference category. The final model included interaction terms to explore the potential for prospective self to moderate the effect of internalizing and externalizing problems.

2.3.3. Population Weights

Weights calibrated to the ACS were created to adjust for potential bias resulting from the non-probability sampling design in the AHRB sample. Unlike model-based methods that address the missingness of specific variables, weighting is commonly employed because it is independent of the survey variables of interest [22,23]. The weighted ACS data for individuals aged 15–19 are used to estimate the population distribution and post-stratification weights are then calculated for the AHRB sample. This process involves repeatedly matching the ACS and AHRB data based on the following demographic characteristics: sex, race and ethnicity, and parental education status. Additional details are provided in Supplementary Section 2.

3. Results

3.1. Descriptive Statistics

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Descriptive statistics for the weighted sample are presented in Table 1. Participants had a mean age of 16.8 years of age and were predominantly male (50.5%), White non-Hispanic (55.1%), and with parents who had completed at least some college (70.2%) (*see Supplementary Table S1 for unweighted parameters*). Zero-order correlations among all the variables are reported in Table 2. Externalizing and internalizing problems were positively associated with both alcohol and marijuana use, while prospective self was negatively associated with both alcohol and marijuana use. Prospective self was negatively associated with both externalizing and internalizing problems.

Table 1. Weighted Sociodemographic Characteristics of Participants (N = 2017).

Demographic Information	
Age, *M* (*SD*)	16.8 (1.1)
Sex, *n* (%) female	985 (49.5)
Race/Ethnicity, *n* (%)	
Black or African American non-Hispanic	291 (14.4)
White non-Hispanic	1110 (55.1)
Hispanic all races	419 (8.0)
Other	123 (6.1)
More than one race non-Hispanic	76 (3.6)
Current level of education, *n* (%)	
10th grade	887 (44.0)
12th grade	1130 (56.0)
Average Level Parent Education, *n* (%)	
Completed less than grade school	27 (1.4)
Some high school	174 (9.0)
Completed high school	375 (19.4)
Some college	439 (22.8)
Completing college	600 (31.2)
Graduate or professional school after college	313 (16.2)

Table 2. Means, Standard Deviations, and Pearson Correlation Matrix for Study Variables.

Variable	*M*	*S.E.*	1	2	3	4	5	6	7
1. Externalizing Problems (categorical)	.15	.46	—						
2. Internalizing Problems (categorical)	.27	.63	.31***	—					
3. Externalizing Problems (*T*-score)	51.13	10.06	.62***	.38***	—				
4. Internalizing problems (*T* score)	54.37	11.46	.32***	.71***	.57***	—			
5. Prospective Self	-.001	.20	-.27***	-.13***	-.35***	-.12***	—		
6. Alcohol Use Occasions	1.11	1.49	.28***	.06*	.41***	.10***	-.12***	—	
7. Marijuana Use Occasions	.79	1.69	.34***	.07*	.38***	.10***	-.17***	.55***	—

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

3.2.1. Alcohol

For alcohol use, we hypothesized that externalizing behavior problems and alcohol use would have a positive relationship, while prospective self would be associated with decreased alcohol use.

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Moreover, we hypothesized that internalizing behavior problems would not be associated with alcohol use. Consistent with our hypothesis, an increase in externalizing behavior problems is significantly associated with an increase in alcohol use at the borderline clinical (b =1.33, p <.001) and clinical (b = 1.90, p <.001) ranges. An increase in prospective self was associated with a decrease in alcohol use (b = − 0.71, p = .001). For internalizing behavior problems findings differ at the borderline clinical and clinical ranges. At the borderline clinical range, there was no significant association between alcohol use and internalizing behavior problems (b = − 0.12, p > .05). However, at the clinical range, there is a significant negative association where a decrease in internalizing behavior problems is associated with an increase in alcohol use (b = −0.31, p = .02). These results remained consistent, even when adjusting for covariates (*Model 2, Table 3*).

Table 3. Multi-Level Models: Associations Between Internalizing Problems, Externalizing Problems, and Prospective Self (IV) and 12-Month Alcohol Use.

Predictors	Model 1			Model 2			Model 3		
	b	*SE*	p	b	*SE*	p	b	*SE*	p
12-Month Self-Reported Alcohol Use									
Intercept	0.95	0.12	<0.001	0.86	.11	<0.001	0.87	.11	<0.001
Sex (ref=female)									
Male	−0.25	0.09	0.004	−0.28	0.08	<0.001	−0.28	0.08	<0.001
Subject Grade (ref=10th grade)									
12th grade	0.74	0.08	<0.001	0.73	0.08	<0.001	0.72	0.08	<0.001
Race/Ethnicity (ref=White non-Hispanic)									
Black or African American non-Hispanic	−0.57	0.09	0.001	−0.58	0.08	<0.001	−0.58	0.09	<0.001
Hispanic all races	−0.29	0.14	0.03	−0.30	0.13	0.02	−0.30	0.13	0.02
Other	−0.69	0.17	<0.001	−0.58	0.16	<0.001	−0.58	0.16	<0.001
More than one race non-Hispanic	−0.28	0.13	0.03	−0.33	0.13	0.01	−0.34	0.13	0.01
Average Parent Education (ref=graduate school or professional school after college)									
Completed grade school or less	0.19	0.53	0.71	0.14	0.50	0.79	0.14	0.50	0.78
Some high school	0.16	0.24	0.52	0.17	0.24	0.46	0.18	0.24	0.46
Completed high school	0.02	0.14	0.91	−0.04	0.13	0.76	−0.04	0.14	0.76
Some college	0.09	0.13	0.49	0.14	0.12	0.26	0.14	0.12	0.27
Completed college	0.07	0.13	0.61	0.12	0.12	0.34	0.11	0.12	0.35
Externalizing Behavior Problems (ref=WNL)									
Borderline clinical range				1.33	0.21	<0.001	1.33	0.23	<0.001
Clinical range				1.90	0.21	<0.001	1.90	0.30	<0.001
Internalizing Behavior Problems (ref=WNL)									
Borderline clinical range				−0.12	0.14	0.36	−0.13	0.14	0.36
Clinical range				−0.30	0.13	0.02	−0.28	0.13	0.03
Prospective Self				−0.71	0.22	0.001	−0.78	0.25	0.002
Externalizing Behavior*Prospective Self									
Borderline clinical range							−0.02	0.99	0.98
Clinical range							−0.18	1.08	0.87
Internalizing Behavior*Prospective Self									
Borderline clinical range							0.40	0.83	0.63

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Clinical range	0.59	0.70	0.40

In an exploratory analysis, we examined the interactions of externalizing problems with prospective self and internalizing problems with prospective self to evaluate whether higher levels of prospective self may have served as a protective factor in lower alcohol use for adolescents with higher scores on externalizing and internalizing behavior problems. None of the interactions were significant (*Model 3, Table 3*).

3.2.2. Marijuana

For marijuana use, we hypothesized that higher levels of externalizing and internalizing behavior problems would be associated with increased marijuana use. We also hypothesized that the higher prospective self would be associated with lower marijuana use. Our results partially support our hypotheses, where higher levels of externalizing behavior problems at the borderline clinical (b = 1.57, p <.001) and clinical ranges (b = 2.64, p = 000) were significantly associated with an increase in marijuana use. Findings were not significant for internalizing behavior problems at both the borderline clinical (b = −0.15, p > .05) and clinical (b = −0.28, p > .05) ranges. Consistent with our hypothesis, an increase in prospective self is significantly associated with a decrease in marijuana use (b = −1.02, p =.001). These results remained consistent, even when adjusting for covariates (*Model 2, Table 4*).

Table 4. Multi-Level Models: Associations Between Internalizing Problems, Externalizing Problems, and Prospective Self (IV) and 12-Month Marijuana Use.

Predictors	Model 1			Model 2			Model 3		
	b	*SE*	p	b	*SE*	p	b	*SE*	p
12-Month Self-Reported Marijuana Use									
Intercept	0.38	0.14	0.005	0.27	0.13	0.04	0.29	0.13	0.03
Sex (ref=female)									
Male	0.07	0.11	0.55	0.06	0.11	0.58	0.04	0.11	0.72
Subject Grade (ref=10th grade)									
12th grade	0.65	0.11	<0.001	0.60	0.11	<0.001	0.60	0.11	<0.001
Race/Ethnicity (ref=White non-Hispanic)									
Black or African American non-Hispanic	−0.16	0.13	0.22	−0.13	0.12	0.29	−0.13	0.12	0.28
Hispanic all races	0.29	0.24	0.22	0.30	0.23	0.19	0.33	0.22	0.14
Other	−0.72	0.12	<0.001	−0.58	0.12	<0.001	−0.61	0.11	<0.001
More than one race non-Hispanic	0.22	0.18	0.23	0.15	0.19	0.55	0.11	0.19	0.56
Average Parent Education (ref=graduate school or professional school after college)									
Completed grade school or less	−0.61	0.32	0.06	−0.69	0.31	0.02	−0.78	0.32	0.01
Some high school	0.43	0.33	0.12	0.45	0.31	0.14	0.44	0.31	0.15
Completed high school	0.28	0.21	0.17	0.18	0.19	0.33	0.17	0.18	0.36
Some college	0.04	0.16	0.79	0.04	0.09	0.15	0.08	0.15	0.61
Completed college	−0.08	0.15	0.62	−0.01	0.14	0.94	−0.02	0.14	0.89
Externalizing Behavior Problems (ref=WNL)									
Borderline clinical range				1.57	0.35	<0.001	1.52	0.37	<0.001
Clinical range				2.64	0.40	<0.001	2.70	0.50	<0.001

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Internalizing Behavior Problems (ref=WNL)						
Borderline clinical range	−0.15	0.21	0.50	−0.17	0.21	0.43
Clinical range	−0.28	0.18	0.13	−0.23	0.17	0.19
Prospective Self	−1.02	0.32	0.001	−1.10	0.35	0.001
Externalizing Behavior*Prospective Self						
Borderline clinical range				−1.87	1.79	0.30
Clinical range				−0.72	1.74	0.68
Internalizing Behavior*Prospective Self						
Borderline clinical range				−0.07	1.48	0.96
Clinical range				2.04	0.97	0.04

The interaction of externalizing problems with prospective self did not add significantly to the prediction of marijuana use (*Model 3, Table 4*). However, the interaction between internalizing behavior with prospective self was significant and positive (b = 2.04, p = .04), suggesting that adolescents with both high internalizing problems and high prospective self engaged in higher marijuana use.

3.3. Sensitivity and Exploratory Analyses

3.3.1. Comparison between Weighted and Unweighted Analyses

All analyses were originally run without using population weights. Though our weights increased variance, thus reducing power, we are presenting them as our main results as they increase the generalizability of our findings. Except for the association between internalizing (at the clinical range) with prospective self on alcohol use changing in magnitude and significance threshold from unweighted (b = −0.19, p = .11) to weighted (b = −0.31, p =.02), the remaining interpretations are largely unchanged (*see Supplementary Tables S2, S3*).

3.3.2. Categorized vs. T-Scores for Internalizing and Externalizing Problem

We re-coded internalizing and externalizing scores in our main analyses to focus on the effects of risk and protective factors on more severe levels of alcohol and marijuana use compared to nonclinical levels. We also conducted the same linear regression analyses using *T*-score internalizing and externalizing behavior problem scores.

Most of the interpretations remain the same. A notable difference is observed for prospective self. Specifically, in the categorical models, prospective self is consistently negatively associated with alcohol and marijuana use (*see supplementary Tables S2, S3*). In contrast, in the continuous *T*-score models, prospective self is no longer significant for alcohol use (*see Supplementary Tables S4, S5*). The exception is Model 3 for marijuana use, where a higher level of prospective self is associated with increased marijuana use (b = 3.05, p =.004; *see supplementary Table S5, Model 3*). Additionally, while internalizing behavior problems are not a significant predictor of marijuana use in the categorical models, a higher level of internalizing behavior problems is negatively associated with a decrease in marijuana use in the *T*-score model (b = 0.08, p <.001; *see Supplementary Tables S3, S5*). Finally, unlike in the categorical model, the interaction between externalizing problems and prospective self adds significantly to the prediction of marijuana use (b = − 0.09, p <.001).

3.3.3. Internalizing and Externalizing Problems Interaction

Given that internalizing and externalizing behavior problems often co-occur among adolescents with substance-use issues [25], we conducted separate linear regression analyses for alcohol and marijuana use, including our covariates, predictors, and the interaction between internalizing and externalizing behavior problems. For our weighted analyses, the interactions between internalizing

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and externalizing problems were not significant for both alcohol and marijuana use. In contrast, some levels of the interaction were significant for alcohol and marijuana use outcomes (*see Supplementary Tables S6, S7*). Specifically, having externalizing problems at a clinical range and internalizing problems at a borderline clinical range is associated with an increase in alcohol use ($b = 0.99$, $p = .03$). Having a borderline clinical range of externalizing and a borderline clinical range of internalizing problems was associated with a decrease in marijuana use ($b = -1.43$; $p = .007$). Finally, having a clinical range of externalizing problems and a borderline clinical range of internalizing problems was associated with an increase in marijuana use ($b = 2.10$; $p < .001$).

4. 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 control for potentially confounding factors, we also covaried race, ethnicity, sex, school age, and parental education in the first model of all regressions. Finally, we assessed the effects of the interactions of internalizing problems with prospective self and externalizing problems with prospective self to determine whether there were associations beyond their individual relationships with substance use.

4.1. Alcohol

For alcohol use, we hypothesized that externalizing behavior problems would positively correlate with alcohol use, while a higher prospective self would be linked to decreased alcohol use. We also hypothesized that internalizing behavior problems would not be associated with alcohol use. Consistent with our hypothesis, a higher level of externalizing behavior problems was significantly associated with lower alcohol use and a higher level of prospective self is associated with less alcohol use. For internalizing behavior problems, at the clinical range, lower levels of internalizing behavior problems were significantly associated with higher alcohol use. We also tested whether higher levels of prospective self may have served as a protective factor against alcohol use among adolescents with higher externalizing and internalizing behavior problem scores. None of the interactions were significant, indicating no differential susceptibility to alcohol use among adolescents with higher levels of internalizing or externalizing behavior problems.

Our results regarding the positive relationship between externalizing behavior problems and alcohol use occasions are consistent with other research findings [26–28]. An explanation for this relationship could be the positive association between increased externalizing behavior problems and increased socialization with delinquent peers [26]. Though only the more severe range of internalizing behavior problems was associated with increased alcohol use, our results follow the direction of other studies [26,28,29]. A potential explanation for the negative association is that internalizing behavior problems serve as a protective factor against delinquent peer association and, therefore, early alcohol use [26,29]. For instance, 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 [29].

4.2. Marijuana

For marijuana use, we hypothesized that higher levels of externalizing and internalizing behavior problems would be associated with increased marijuana use, while a higher prospective self would be linked to lower marijuana use. Our results partially supported these hypotheses. Higher levels of externalizing behavior problems were significantly associated with greater marijuana use. However, findings for internalizing behavior problems were not significant. Consistent with our hypothesis, an increase in prospective self was significantly associated with lower marijuana use.

We also examined whether higher levels of prospective self may have served as a protective factor against marijuana use for adolescents with higher scores on externalizing and internalizing behavior problems. None of the interactions between externalizing problems and prospective self

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were significant, indicating no differential susceptibility to marijuana use among adolescents with higher levels of externalizing behavior problems. However, the interaction between (clinical range) internalizing behavior problems and prospective self was significant and positive, suggesting that adolescents with both higher internalizing problems and higher prospective self engage in greater marijuana use, beyond their individual predictions.

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 [30,31]. However, other research has suggested that while externalizing behavior problems relate to marijuana use, other factors are also powerful predictors of marijuana use [34]. For example, according to Korhonen et al. (2010), early-onset smoking is associated with cannabis use.

Our nonsignificant association between internalizing problems and marijuana use adds to the mixed research findings on this question [8,30,32,33,35]. While some findings suggest greater internalizing behavior problems are associated with less marijuana use [8,30], others suggest internalizing behavior problems to be positively associated with marijuana use [33,36], and others found no association [32,35]. A potential explanation for not having found a significant association is that we looked at more severe levels of internalizing problems, and at more severe levels, internalizing behaviors are not a significant risk factor. To further this point, in the *T*-score models, internalizing behavior problems were significantly negative across all three models, meaning that an increase in internalizing problems is associated with decreased marijuana use. The negative association in our *T*-score models may be explained by the fact we control for externalizing problems. Research suggests that internalizing behavior problems serve as a protective factor when controlling for externalizing problems; when looking at the co-occurrence of internalizing and externalizing problems, there seems to be a weak positive association [8]. Another potential explanation for our findings could be that substance use in adolescence is primarily used in social contexts, and since social withdrawal often accompanies internalizing symptoms, these symptoms can serve as a protective factor [8]. Additionally, fear and worry are also two characteristics of internalizing symptoms that may deter adolescents from taking risks, such as using marijuana [8].

Interestingly, we found a significant positive contribution from the interaction between clinical range internalizing behavior and prospective self, which suggests that adolescents with both high internalizing problems and high prospective self engage in higher levels of marijuana use. Our findings might underscore a potentially higher-risk population of adolescents that exhibit future orientation, academic aspiration, and resistance to peer influence but also have high internalizing symptoms. A potential explanation for our finding could be the changed perceptions of marijuana use that may stem from the changes in legalization. The perception that marijuana is not harmful, in turn, may influence adolescents' decision to use it as self-medication to relieve internalizing symptoms, such as depression. Though studies have found weak effects on the use of cannabis for self-medication [12,37], our study may unveil a change in marijuana use and perception. In 2008, medical use of marijuana was legalized in Michigan, and then in 2018, recreational use was legalized. Recent studies examining the impact of legalization on youth marijuana use and perceptions offer mixed results. Two studies found little to no differences in perceptions of marijuana use among adolescents after the legalization of recreational use of marijuana in Washington state [38,39]; however, one study found increases in problems and use disorder symptoms [38]. Data collected from secondary school students generally suggests decreases in perceived harmlessness and increases in marijuana use, yet not consistently. For example, researchers examining the effects of marijuana legalization on youth in Washington and Colorado found that among 8th and 10th graders in Washington, perceived harmfulness of marijuana use decreased and marijuana use increased after the legalization of recreational use [40]; however, no significant difference was found among 12th graders, suggesting that younger adolescents might be more vulnerable to the policy changes [40]. However, they found no significant differences in either perceived harmfulness or marijuana use among Colorado students. Nationally, Monitoring the Future data does indicate a sharp increase in adolescent perception of marijuana as not harmful, with one-fifth of 12th graders perceiving people who use marijuana regularly as posing no risk or harm to their health [41]. Additional research is

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needed to fully understand the long term effect of policy changes on adolescent perception and use of marijuana. Our study contributes to the ongoing discourse by highlighting the potential impact of changing marijuana perceptions.

4.3. Prospective Self

Prospective self is composed of future orientation, academic aspiration, and resistance to peer influence. Our results indicate that at more severe levels of internalizing and externalizing behavior problems, 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. Our findings are consistent with the only other study examining the relationship between prospective self and externalizing behavior problems [13]. While prospective self is a new construct introduced by Zinn et al., 2020, 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 [42,43]. On the contrary, less positive future orientation was significantly associated with alcohol during sex, more alcohol problems, and increased substance use [43].

Moreover, research has shown consistent results that compared to adolescent substance users, non-users tend to have higher academic aspirations [44]. 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 [45].

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 [16,46]. 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 [16,47].

4.4. Implications

4.4.1. Prevention

The findings from the present study have implications for the prevention and treatment of alcohol and marijuana use. Given that there is a significant relationship between externalizing behavior problems and alcohol use, 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, offering prevention activities for youth who display either internalizing behavior problems, externalizing behavior problems, or a combination could also be extremely beneficial. Previous research suggests that internalizing and externalizing behavior problems play a role in the developmental pathways to substance use [5,6,8,10,12]. Research on family prevention treatments for youth more vulnerable to high-risk behaviors has been effective in preventing antisocial and problem behaviors, but more research should be conducted to better understand the efficacy of incorporating substance use prevention strategies into programs for youth with externalizing and internalizing behavior problems [48,49].

Moreover, prospective self appears to function as a significant protective factor, suggesting that prevention programs that focus on strengthening an adolescent's future orientation, resistance to peer influence, and academic aspirations may be effective in preventing alcohol and marijuana use. To our knowledge, there are no prevention programs that address all aspects of prospective self; however, 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 summer school prevention program for 6th and 7th graders can support future prevention of substance use [49].

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4.4.2. Intervention

Like with prevention programs, our results also suggest avenues for programs intended to reduce adolescent alcohol and marijuana use (i.e., secondary prevention and/or substance use treatment). Given that there is a significant relationship between externalizing behavior problems and alcohol use, addressing externalizing behavior problems may have an effect on decreasing alcohol use. For marijuana, interventions that address internalizing and/or externalizing behavior problems may also have an effect on decreasing youth marijuana use. In considering our results, addressing internalizing and externalizing behaviors as part of substance use interventions may enhance their treatment journey. Finally, incorporating strategies that strengthen one's prospective self may offer additional benefits for reducing alcohol and marijuana use. Future research should explore the effects of incorporating strategies that foster prospective self into substance use treatment programs.

4.5. Future Research

Our results open a new avenue for research on 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. Our study provided insight into the relationship between internalizing and externalizing behavior problems separately with alcohol and marijuana use, but it did not focus on the co-occurrence of internalizing and externalizing behaviors as a risk factor. Future research should examine the impact of co-occurring conditions on substance use.

Finally, since prospective self is a new latent construct, additional research is needed on its relation to adolescent substance use. Zinn et al. (2020) suggest that the 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, further research could identify what prospective self may be a protective factor for, and how it may be incorporated into prevention and treatment programs.

4.6. Limitations and Strengths

4.6.1. 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; therefore, results may not be as generalizable to youth with higher levels of alcohol and marijuana use. Thus, our results may be more applicable to adolescents who report lower levels of alcohol and marijuana use. Second, our measure of alcohol and marijuana use occasions was in the past 12 months. Since a year is a long time, adolescents may have had difficulty recalling the number of occasions resulting in an underreporting of alcohol and marijuana use in our sample. Yet, assessing past 12-month alcohol and marijuana use is common practice in research with adolescent populations as, overall, adolescents tend to be occasional and less frequent users. Another 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 [2]. An explanation for our findings is that the sample may have had 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.

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4.6.3. Strengths

Despite our limitations, the present study has a number of strengths. First, we had a large sample size (n=2017), which 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. 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 the broader U.S. adolescent population. Using weighted analyses adds additional confidence to the generalizability and, thus, population validity of the results [50].

Supplementary Materials: The following supporting information can be downloaded at the website of this paper posted on Preprints.org, Table S1: Unweighted Sociodemographic Characteristics of Participants (N=2,017); Table S2: Multi-Level Models: Associations Between Internalizing Problems, Externalizing Problems, and Prospective Self (IV) and 12-Month Alcohol Use (Unweighted); Table S3: Multi-Level Models: Associations Between Internalizing Problems, Externalizing Problems, and Prospective Self (IV) and 12-Month Marijuana Use (Unweighted); Table S4: Multi-Level Models: Associations Between t-Score Internalizing Problems, Externalizing Problems, and Prospective Self (IV) and 12-Month Alcohol Use; Table S5: Multi-Level Models: Associations Between t-Score Internalizing Problems, Externalizing Problems, and Prospective Self (IV) and 12-Month Marijuana Use; Table S6: Associations Between Internalizing Problems, Externalizing Problems, and Prospective Self (IV) with Internalizing and Externalizing Interaction and 12-Month Alcohol Use (unweighted vs. weighted); Table S7:Associations Between Internalizing Problems, Externalizing Problems, and Prospective Self (IV) with Internalizing and Externalizing Interaction and 12-Month Marijuana Use (unweighted vs. weighted).

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References

1. Teenage Drug Use Statistics [2023]: Data & Trends on Abuse Available online: https://drugabusestatistics.org/teen-drug-use/ (accessed on 11 April 2023).
2. Underage Drinking | CDC Available online: https://www.cdc.gov/alcohol/fact-sheets/underage-drinking.htm (accessed on 11 April 2023).
3. CDC Cannabis and Teens Available online: https://www.cdc.gov/cannabis/health-effects/cannabis-and-teens.html (accessed on 28 July 2024).
4. Samek, D.R.; Hicks, B.M. Externalizing Disorders and Environmental Risk: Mechanisms of Gene-Environment Interplay and Strategies for Intervention. Clin Pract (Lond) 2014, 11, 537–547, doi:10.2217/CPR.14.47.
5. Couwenbergh, C.; van den Brink, W.; Zwart, K.; Vreugdenhil, C.; van Wijngaarden-Cremers, P.; van der Gaag, R.J. Comorbid Psychopathology in Adolescents and Young Adults Treated for Substance Use Disorders: A Review. Eur Child Adolesc Psychiatry 2006, 15, 319–328, doi:10.1007/s00787-006-0535-6.
6. Miettunen, J.; Murray, G.K.; Jones, P.B.; Mäki, P.; Ebeling, H.; Taanila, A.; Joukamaa, M.; Savolainen, J.; Törmänen, S.; Järvelin, M.-R.; et al. Longitudinal Associations between Childhood and Adulthood Externalizing and Internalizing Psychopathology and Adolescent Substance Use. Psychol Med 2014, 44, 1727–1738, doi:10.1017/S0033291713002328.
7. Zahn–Waxler, C.; Klimes–Dougan, B.; Slattery, M.J. Internalizing Problems of Childhood and Adolescence: Prospects, Pitfalls, and Progress in Understanding the Development of Anxiety and Depression. Development and Psychopathology 2000, 12, 443–466, doi:10.1017/S0954579400003102.

8. Colder, C.R.; Scalco, M.; Trucco, E.M.; Read, J.P.; Lengua, L.J.; Wieczorek, W.F.; Hawk, L.W. Prospective Associations of Internalizing and Externalizing Problems and Their Co-Occurrence with Early Adolescent Substance Use. J Abnorm Child Psychol 2013, 41, 667–677, doi:10.1007/s10802-012-9701-0.
9. King, S.M.; Iacono, W.G.; McGue, M. Childhood Externalizing and Internalizing Psychopathology in the Prediction of Early Substance Use. Addiction 2004, 99, 1548–1559, doi:10.1111/j.1360-0443.2004.00893.x.
10. Hussong, A.M.; Jones, D.J.; Stein, G.L.; Baucom, D.H.; Boeding, S. An Internalizing Pathway to Alcohol Use and Disorder. Psychol Addict Behav 2011, 25, 390–404, doi:10.1037/a0024519.
11. Rieselbach, M.M.; Gresko, S.; Corley, R.P.; Hewitt, J.K.; Rhee, S.H. An Examination of the Protective Role of Internalizing Symptoms in Adolescent Substance Use. J Psychopathol Behav Assess 2024, 46, 12–24, doi:10.1007/s10862-024-10119-2.
12. Colder, C.R.; Frndak, S.; Lengua, L.J.; Read, J.P.; Hawk, L.W.; Wieczorek, W.F. Internalizing and Externalizing Problem Behavior: A Test of a Latent Variable Interaction Predicting a Two-Part Growth Model of Adolescent Substance Use. J Abnorm Child Psychol 2018, 46, 319–330, doi:10.1007/s10802-017-0277-6.
13. Zinn, M.E.; Huntley, E.D.; Keating, D.P. Resilience in Adolescence: Prospective Self Moderates the Association of Early Life Adversity with Externalizing Problems. Journal of Adolescence 2020, 81, 61–72, doi:10.1016/j.adolescence.2020.04.004.
14. Steinberg, L.; Graham, S.; O'Brien, L.; Woolard, J.; Cauffman, E.; Banich, M. Age Differences in Future Orientation and Delay Discounting. Child Development 2009, 80, 28–44, doi:10.1111/j.1467-8624.2008.01244.x.
15. Steinberg, L.; Monahan, K.C. Age Differences in Resistance to Peer Influence. Developmental Psychology 2007, 43, 1531–1543, doi:10.1037/0012-1649.43.6.1531.a
16. Kandel, D.B. On Processes of Peer Influences in Adolescent Drug Use: A Developmental Perspective. Adv Alcohol Subst Abuse 1985, 4, 139–163, doi:10.1300/J251v04n03_07.
17. Bordin, I.A.; Rocha, M.M.; Paula, C.S.; Teixeira, M.C.T.V.; Achenbach, T.M.; Rescorla, L.A.; Silvares, E.F.M. Child Behavior Checklist (CBCL),Youth Self-Report (YSR) and Teacher's Report Form(TRF): An Overview of the Development of the Original and Brazilian Versions. Cadernos de Saúde Pública 2013, 29, 13–28.
18. Achenbach, T.M.; Rescorla, L.A. Manual for the ASEBA School-Age Forms & Profiles; University of Vermont, Research Center for Children, Youth, & Families: Burlington, VT, USA, 2001.
19. Steinberg, L.; Graham, S.; O'Brien, L.; Woolard, J.; Cauffman, E.; Banich, M. Age Differences in Future Orientation and Delay Discounting. Child Development 2009, 80, 28–44, doi:10.1111/j.1467-8624.2008.01244.x.
20. Steinberg, L.; Monahan, K.C. Age Differences in Resistance to Peer Influence. Developmental Psychology 2007, 43, 1531–1543, doi:10.1037/0012-1649.43.6.1531.
21. Johnston, L.; Miech, R.; O'Malley, P.; Bachman, J.; Schulenberg, J.; Patrick, M. Monitoring the Future national survey results on drug use, 1975-2019: Overview, key findings on adolescent drug use 2020.
22. Bachman, J.G.; O'Malley, P.M.; Johnston, L.D.; Schulenberg, J.E.; Wallace, J.M. Racial/Ethnic Differences in the Relationship Between Parental Education and Substance Use Among U.S. 8th-, 10th-, and 12th-Grade Students: Findings From the Monitoring the Future Project. J. Stud. Alcohol Drugs 2011, 72, 279–285, doi:10.15288/jsad.2011.72.279.
23. Demidenko, M.I.; Huntley, E.D.; Du, L.; Estor, C.; Si, Y.; Wagner, C.; Clarke, P.; Keating, D.P. Individual and Community Level Developmental Adversities: Associations with Marijuana and Alcohol Use in Late-Adolescents and Young Adults. J. Youth Adolescence 2024, 53, 799–813, doi:10.1007/s10964-023-01881-9.
24. StataCorp. Stata Statistical Software: Release 18; StataCorp LLC: College Station, TX, USA, 2023.
25. Chan, Y.-F.; Dennis, M.L.; Funk, R.R. Prevalence and Comorbidity of Major Internalizing and Externalizing Problems among Adolescents and Adults Presenting to Substance Abuse Treatment. J Subst Abuse Treat 2008, 34, 14–24, doi:10.1016/j.jsat.2006.12.031.
26. Fite, P.J.; Colder, C.R.; O'Connor, R.M. Childhood Behavior Problems and Peer Selection and Socialization: Risk for Adolescent Alcohol Use. Addictive Behaviors 2006, 31, 1454–1459, doi:10.1016/j.addbeh.2005.09.015.
27. Helstrom, A.; Bryan, A.; Hutchison, K.E.; Riggs, P.D.; Blechman, E.A. Tobacco and Alcohol Use as an Explanation for the Association between Externalizing Behavior and Illicit Drug Use among Delinquent Adolescents. Prevention Science 2004, 5, 267–277, doi:10.1023/B:PREV.0000045360.23290.8f.

 doi:10.20944/preprints202408.0823.v1

28. Stice, E.; Barrera, M. A Longitudinal Examination of the Reciprocal Relations between Perceived Parenting and Adolescents' Substance Use and Externalizing Behaviors. Developmental Psychology 1995, 31, 322–334, doi:10.1037/0012-1649.31.2.322.
29. Edwards, A.C.; Latendresse, S.J.; Heron, J.; Cho, S.B.; Hickman, M.; Lewis, G.; Dick, D.M.; Kendler, K.S. Childhood Internalizing Symptoms Are Negatively Associated with Early Adolescent Alcohol Use. Alcoholism: Clinical and Experimental Research 2014, 38, 1680–1688, doi:10.1111/acer.12402.
30. Steele, R.G.; Forehand, R.; Armistead, L.; Brody, G. Predicting Alcohol and Drug Use in Early Adulthood: The Role of Internalizing and Externalizing Behavior Problems in Early Adolescence. American Journal of Orthopsychiatry 1995, 65, 380–388, doi:10.1037/h0079694.
31. Hayatbakhsh, M.R.; McGee, T.R.; Bor, W.; Najman, J.M.; Jamrozik, K.; Mamun, A.A. Child and Adolescent Externalizing Behavior and Cannabis Use Disorders in Early Adulthood: An Australian Prospective Birth Cohort Study. Addictive Behaviors 2008, 33, 422–438, doi:10.1016/j.addbeh.2007.10.004.
32. Griffith-Lendering, M.F.H.; Huijbregts, S.C.J.; Mooijaart, A.; Vollebergh, W. a. M.; Swaab, H. Cannabis Use and Development of Externalizing and Internalizing Behaviour Problems in Early Adolescence: A TRAILS Study. Drug Alcohol Depend 2011, 116, 11–17, doi:10.1016/j.drugalcdep.2010.11.024.
33. Wasserman, A.M.; Shaw-Meadow, K.J.; Moon, T.J.; Karns-Wright, T.E.; Mathias, C.W.; Hill-Kapturczak, N.; Dougherty, D.M. The Externalizing and Internalizing Pathways to Marijuana Use Initiation: Examining the Synergistic Effects of Impulsiveness and Sensation Seeking. Developmental Psychology 2021, 57, 2250–2264, doi:10.1037/dev0001267.
34. Korhonen, T.; van Leeuwen, A.P.; Reijneveld, S.A.; Ormel, J.; Verhulst, F.C.; Huizink, A.C. Externalizing Behavior Problems and Cigarette Smoking as Predictors of Cannabis Use: The TRAILS Study. J Am Acad Child Adolesc Psychiatry 2010, 49, 61–69, doi:10.1097/00004583-201001000-00010.
35. Farmer, R.F.; Seeley, J.R.; Kosty, D.B.; Gau, J.M.; Duncan, S.C.; Lynskey, M.T.; Lewinsohn, P.M. Internalizing and Externalizing Psychopathology as Predictors of Cannabis Use Disorder Onset during Adolescence and Early Adulthood. Psychology of Addictive Behaviors 2015, 29, 541–551, doi:10.1037/adb0000059.
36. Girgis, J.; Pringsheim, T.; Williams, J.; Shafiq, S.; Patten, S. Cannabis Use and Internalizing/Externalizing Symptoms in Youth: A Canadian Population-Based Study. Journal of Adolescent Health 2020, 67, 26–32, doi:10.1016/j.jadohealth.2020.01.015.
37. Womack, S.R.; Shaw, D.S.; Weaver, C.M.; Forbes, E.E. Bidirectional Associations Between Cannabis Use and Depressive Symptoms From Adolescence Through Early Adulthood Among At-Risk Young Men. J. Stud. Alcohol Drugs 2016, 77, 287–297, doi:10.15288/jsad.2016.77.287.
38. Blevins, C.E.; Marsh, E.; Banes, K.E.; Stephens, R.S.; Walker, D.D.; Roffman, R.A. The Implications of Cannabis Policy Changes in Washington on Adolescent Perception of Risk, Norms, Attitudes, and Substance Use. Subst®Abuse 2018, 12, 1178221818815491, doi:10.1177/1178221818815491.
39. Mason, W.A.; Hanson, K.; Fleming, C.B.; Ringle, J.L.; Haggerty, K.P. Washington State Recreational Marijuana Legalization: Parent and Adolescent Perceptions, Knowledge, and Discussions in a Sample of Low-Income Families. Substance Use & Misuse 2015, 50, 541–545, doi:10.3109/10826084.2014.952447.
40. Cerdá, M.; Wall, M.; Feng, T.; Keyes, K.M.; Sarvet, A.; Schulenberg, J.; O'Malley, P.M.; Pacula, R.L.; Galea, S.; Hasin, D.S. Association of State Recreational Marijuana Laws With Adolescent Marijuana Use. JAMA Pediatrics 2017, 171, 142–149, doi:10.1001/jamapediatrics.2016.3624.
41. Sarvet, A.L.; Wall, M.M.; Keyes, K.M.; Cerdá, M.; Schulenberg, J.E.; O'Malley, P.M.; Johnston, L.D.; Hasin, D.S. Recent Rapid Decrease in Adolescents' Perception That Marijuana Is Harmful, but No Concurrent Increase in Use. Drug and Alcohol Dependence 2018, 186, 68–74, doi:10.1016/j.drugalcdep.2017.12.041.
42. Robbins, R.N.; Bryan, A. Relationships Between Future Orientation, Impulsive Sensation Seeking, and Risk Behavior Among Adjudicated Adolescents. Journal of Adolescent Research 2004, 19, 428–445, doi:10.1177/0743558403258860.
43. Jackman, D.M.; MacPhee, D. Self-Esteem and Future Orientation Predict Adolescents' Risk Engagement. The Journal of Early Adolescence 2017, 37, 339–366, doi:10.1177/0272431615602756.
44. Paulson, M.J.; Coombs, R.H.; Richardson, M.A. School Performance, Academic Aspirations, and Drug Use among Children and Adolescents. J Drug Educ 1990, 20, 289–303, doi:10.2190/8J0X-LY6D-PL7W-42FA.
45. Andrews, J.; Smolkowski, K.; Hops, H.; Tildesley, E.; Ary, D.; Harris, J. Adolescent Substance Use and Academic Achievement and Motivation.; San Francisco, August 1991.

46. Bauman, K.E.; Ennett, S.T. On the Importance of Peer Influence for Adolescent Drug Use: Commonly Neglected Considerations. Addiction 1996, 91, 185–198, doi:10.1046/j.1360-0443.1996.9121852.x.
47. Schuler, M.S.; Tucker, J.S.; Pedersen, E.R.; D'Amico, E.J. Relative Influence of Perceived Peer and Family Substance Use on Adolescent Alcohol, Cigarette, and Marijuana Use across Middle and High School. Addict Behav 2019, 88, 99–105, doi:10.1016/j.addbeh.2018.08.025.
48. Dishion, T.J.; Andrews, D.W. Preventing Escalation in Problem Behaviors with High-Risk Young Adolescents: Immediate and 1-Year Outcomes. Journal of Consulting and Clinical Psychology 1995, 63, 538–548, doi:10.1037/0022-006X.63.4.538.
49. Stoddard, S.A.; Hughesdon, K.; Khan, A.; Zimmerman, M.A. Feasibility and Acceptability of a Future-Oriented Empowerment Program to Prevent Substance Use and School Dropout among School-Disengaged Youth. Public Health Nurs 2020, 37, 251–261, doi:10.1111/phn.12706.
50. Keating, D.P. Adolescent Health Risk Behavior: The Road Ahead. Journal of Adolescent Health 2024, 74, 397–399, doi:10.1016/j.jadohealth.2023.12.008