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Abstract

Motives for substance use have garnered considerable attention due to the strong predictive utility of this construct, both in terms of use and problems associated with use. The current study examined the cross-lagged relations between alcohol use and motives, and marijuana use and motives over three yearly assessment periods in a large sample ($N = 526$, 48% male) of college students. The relations between substance use and motives were assessed at each time point, allowing for the examination of these inter-relations over time. Results indicated different trends based on the type of substance. For alcohol use, cross-lagged trends were found between freshman and sophomore year for coping, social, and conformity motives with cross-lagged relations between enhancement motives and alcohol use across all years. However, outside of enhancement motives, cross-lagged relations were not found between sophomore and junior year. In contrast, cross-lagged effects were found for marijuana use and coping, enhancement, and expansion motives between sophomore and junior year, but not freshman year. These results suggest that people's expectations that drinking or smoking marijuana makes activities more reinforcing and helps them cope with distress may perpetuate use. In turn, use itself may enhance these

expectations over time. Results have direct implications for treatment, with recommended focus on motives, behavior activation, and healthy coping skills in order to interrupt the cycle of substance use.

1.0 Introduction

According to the Substance Abuse and Mental Health Services Administration (SAMHSA; 2016), college students are one of the highest risk groups for alcohol use; almost 60% of college students ages 18–22 engaged in alcohol use in the past month. Other substance use is also on the rise among college students with the annual prevalence of marijuana use at 34% (Johnston et al., 2015).

Motives for substance use have garnered considerable attention due to the strong predictive utility of this construct (Carey and Correia, 1997; Simons et al., 2000; Simons et al., 1998). The four most commonly used motives originated in the alcohol use literature, and include enhancement (e.g., drinking is expected to make activities more reinforcing), coping (e.g., drinking is expected to reduce distress), social (e.g., drinking is expected to be sociable), and conformity (e.g., drinking because my friends pressure me to drink; Cooper, 1994). Motives can be positively or negatively valenced and refer to internal or external factors. Further, motives can serve as predicted positive or negative reinforcement, which may influence the maintenance of substance use over time.

Substance use motives also align with biobehavioral theories of problematic substance use, which suggest two distinct risk "pathways" of reward and stress (Koob, 2015; Koob et al., 2004; Kreek et al., 2005). The initiation of substance use and resulting problematic use is based on a hypo-activated physiological response and generalized genetic disposition to reward, which may be particularly relevant for social and enhancement motives. As problematic use develops, the reward system is then compromised and stress pathways, defined by psychological, behavioral, physiological, and biological predispositions, are activated. Stress is associated with more problematic substance use and relapse, which may activate coping or conformity motives in substance users.

1.1 Alcohol Motives

Cross-lagged relations examine how two variables predict each other over time while controlling for baseline levels of both variables. Therefore, the predictive utility and unique variance accounted for by both variables can then be identified, over and above simply the stability of each variable over time. Surprisingly, few studies have examined cross-lagged relations among motives and alcohol use longitudinally, and most focused on only one follow-up time point. Crutzen and colleagues (2013) found that among a sample of adults ($N = 2440$), motives, excluding conformity, were able to predict number of days drinking and number of days drinking was also able to predict increased motives. Further, in a study of

Swiss men ($N = 4575$), cross-lagged relations were present between social motives and risky single occasion drinking as well as between social motives and alcohol consequences (Labhart et al., 2016). In that same study, coping motives and alcohol consequences also displayed a cross-lagged relationship. These are the only two studies that the authors are aware of that have found longitudinal crosslagged relationships between motives and alcohol use.

1.2 Marijuana Motives

There is also evidence that marijuana-related motives may exist as a mechanism to engaging in marijuana use. Simons and colleagues (1998) constructed a marijuana motives measure adapted from Cooper's (1994) drinking motives measure with a fifth subscale assessing "expansion motives," which taps into motivation for experiencing the enhancement of perceptual and cognitive experiences due to marijuana's psychedelic properties.

A limitation of the marijuana motives literature is the lack of longitudinal investigations. Anderson and colleagues (2015) conducted the first (and only, to our knowledge) longitudinal examination of marijuana motives on use and related problems from adolescence through young adulthood. The authors found that over time, both positive and negative reinforcement motives in adolescence were related to increased consumption and problems related to marijuana use in adulthood, though it is unclear whether marijuana use in turn may impact motives in a cyclical effect. Thus, longitudinal data may inform the development of marijuana maintenance theories.

1.3 The Current Study

The current study examined the cross-lagged relations between alcohol and marijuana use and motives in a sample of college students assessed three times over three years. The relations between substance use and motives were assessed at each timepoint, allowing for the examination of these inter-relations over time.

Based upon the wealth of previous work in this area, we hypothesized that there would be significant positive cross-lagged relations between multiple motives and alcohol or marijuana use at each timepoint. More specifically, based upon repeated findings in the alcohol literature, we hypothesized that alcohol use would have positive cross-lagged relations with social, coping, and enhancement motives (Crutzen et al., 2013; Kuntsche et al., 2005; Vernig and Orsillo, 2015) and that marijuana use would have positive cross-lagged relations with enhancement, expansion, social, and coping motives (Benschop et al., 2015; Bonn-Miller et al., 2007; Brodbeck et al., 2007).

2.0 Methods

2.1 Participants

Participants ($N = 526$, 48% male) were recruited from introductory psychology courses and were assessed yearly for three years starting freshman year of college. Recruitment occurred across two years. Average age of participants at assessment was 18.95 years (range = 18.00 to 26.33 years old) with approximately 81% of participants identified as Caucasian.

"High risk" participants were identified via pre-study screening and were sent email invitations to enroll. The goal of this screening was to ensure that the sample contained enough participants at risk for escalating substance use to have sufficient variability to address the questions of interest. Notably, the sample intentionally included non-substance users to study those who developed substance use habits over the course of the study. Students were administered a screening questionnaire developed by the study team to assess the presence of conduct problem behaviors based upon the Diagnostic and Statistical Manual of Mental Disorders IV Conduct Disorder criteria (American Psychiatric Association, 2000), that occurred prior to age 18 (12 items, α = .75). A composite score determined the distribution of scores for predicted substance use risk. "High risk" participants (e.g., those with scores that fell within the top 25% of their gender) identified via this method made up 23.1% of the final sample.

2.2 Measures

Past year alcohol and marijuana use and alcohol and marijuana motives were assessed during all three years of the study. Only data from those endorsing use for alcohol (n = 483; 92% of sample) or marijuana (n = 285; 54% of sample) at any of the three assessment points were used in analyses. Descriptive statistics for the measures are found in Table 1.

2.2.1 Substance use—The Life History Calendar (LHC) is a retrospective interview method for collecting data on life events and behaviors (Caspi et al., 1996) that has been previously used in young adult populations (Pederson et al., 2012; Rueger et al., 2012). For each assessment, participants reported retrospectively on their past year of alcohol or marijuana use. For alcohol and marijuana use, participants selected from seven choices describing the *average amount* they used per occasion during each period (e.g., for alcohol, 1 = 1 drink, 2 = 2 drinks… 6 = 6-10 drinks, and 7 = 10 or more drinks. One drink means 1 beer, 1 shot of liquor, or one glass of wine. For marijuana, 1 = 1-2 hits, 2 = 3-4 hits… 6 = 17 or more hits. One hit is equal to 1 joint, bong, or pipe hit) and *how frequently* they used each substance ranging from 1 (once a month or less) to 5 (every day). The product of the average amount and frequency of use was calculated to determine the average amount used (in drinks or hits) per week for both alcohol and marijuana.

2.2.2 Alcohol motives—Alcohol motives were assessed with the Drinking Motives Questionnaire (Cooper, 1994), a 25 item self-report measure that assesses why the respondent drinks alcohol. Items are assessed on a five point scale (1 = almost never/never… 5 = almost always/always). The DMQ has four first order factors, each assessed by 5 items, including enhancement, coping, social, and conformity (Cooper, 1994). The DMQ demonstrated high internal consistency for all four factors (αs = 0.86 - 0.95).

2.2.3 Marijuana motives—Marijuana motives were assessed with the Marijuana Motives Questionnaire (MMQ; Simons et al., 1998), a 25 item self-report measure that assesses why the respondent smokes marijuana. Items are assessed on a five point scale (1 = almost never/ never… 5 = almost always/always). Factor analysis of the scale indicates that it has five first order factors: enhancement, conformity, expansion, coping, and social (Simons et al., 1998). The MMQ demonstrated high internal consistency for each factor (αs = 0.82 - 0.98).

2.3 Procedure

The study was reviewed and approved by the university's IRB and a federal Certificate of Confidentiality was acquired. A protocol was developed for the study, and all assessments were completed by highly trained undergraduate and graduate students. Training lasted for 3 full-time days and included interviewing skills, sobriety screening, biological sample collection, and physiological data collection. Each year, participants scheduled an appointment to come to the on-campus laboratory and completed the study procedure with trained research assistants. Informed consent was obtained from participants at each assessment.

2.4 Attrition

Data were collected for all 526 participants at Year 1. Of those participants, 483 endorsed alcohol use and 285 endorsed marijuana use at any time point (i.e., Year 1, Year 2, or Year 3). At Year 2, data were collected from 406 participants from the original sample who endorsed alcohol use and 252 participants who endorsed marijuana use. At Year 3, data were collected from 309 participants from the original sample who endorsed alcohol use and 191 participants who endorsed marijuana use. Independent samples t-tests were completed to examine potential differences between study completers vs. non-completers on study variables with no significant group differences on demographic, substance use, and motives variables (t scores ranged from - 1.32 to 1.86; ps > .05), except for both weekly alcohol use and weekly marijuana use in year 3. Those who finished all three waves endorsed higher weekly alcohol and marijuana use compared to those who did not complete all three waves.

2.5 Analyses

Cross-lagged models were analyzed using Mplus 7.2 (Muthén and Muthén, 1998-2012). Due to several non-normally distributed variables, maximum likelihood estimation with robust standard errors was used to account for missing data (Muthén and Muthén, 1998-2012). Models were guided by correlations among variables (see Table 2 for alcohol, Table 3 for marijuana) with separate models run for each motive for alcohol use and then marijuana use over three years. Due to non-significant correlations, conformity and marijuana use were not investigated. Variables collected at the same time point (e.g., marijuana use and social motives in year 1) were correlated. Lastly, variables from year one and year three were correlated with themselves (e.g., marijuana use at time 1 and time 3). Goodness of fit was determined using chi-square statistics, root mean square estimation approximation (RMSEA), and the comparative fit index (CFI; Kline, 2005). All models displayed acceptable fit.

3.0 Results

3.1 Alcohol and Motives

Initial levels of coping motives and alcohol use from year one were used to predict both coping motives and weekly alcohol use one and two years later. All three years are included in the same model; therefore, results from year to year have already accounted for the previous year's levels of motives and use and represent increases in endorsement or use. As

hypothesized, significant cross-lagged relations were observed from year 1 to year 2 (see Figure 1). Coping motives in year 1 ($\beta = 0.16$, $p < 0.001$) predicted increased weekly alcohol use in year 2, over and above baseline levels of weekly alcohol use in year 1, whereas weekly alcohol use in year 1 ($\beta = 0.13$, $p < 0.01$) predicted increased coping motives in year 2, over and above baseline levels of coping motives in year 1. During year three, there was a marginal relationship between weekly alcohol use in year 2 and increased coping motives in year 3 ($\beta = 0.08$, $p = 0.08$), suggesting that weekly alcohol use in year 2 may predict increases in coping motives in year 3, but there was no significant relationship between coping motives in year 2 and later increased weekly alcohol use in year 3 ($\beta = 0.07$, $p = 0.23$). Further, based on the strength of their coefficients, both coping motives ($\beta = 0.54-0.57$, $p < 0.001$) and weekly alcohol use ($\beta = 0.65-0.70$, $p < 0.001$) indicate strong stability over each year, affirming their test-retest reliability.

This same pattern of results, where significant cross-lagged effects were found between motives and weekly alcohol use between year 1 and year 2, was found for social motives ($\beta = 0.15 - 0.21$, $p < 0.001$) and conformity motives ($\beta = 0.07 - 0.14$, $p < 0.05$), suggesting that alcohol use and motives could predict increases in one another over time. Moreover, based on coefficient strength, motives and weekly alcohol use continued to show stability across all three years ($\beta = 0.40 - 0.64$, $p < 0.001$). Interestingly, only enhancement motives showed significant positive cross-lagged relations for all three years (see Figure 2; $\beta = 0.10 - 0.20$, $p < 0.05$).

3.2 Marijuana and Motives

Paralleling alcohol models, initial levels of weekly marijuana use and coping motives were entered to predict increases in weekly marijuana use and coping motives in year 2, which then were used to predict increases in weekly marijuana use and coping motives in year 3. Thus, results from year to year control for the previous year's levels of motives and use. Year 1 coping motives significantly predicted increased weekly marijuana use in year 2 ($\beta = 0.21$, $p < 0.01$), beyond baseline levels of weekly marijuana use in year 1, but weekly marijuana use in year 1 did not significantly predict change in coping motives in year 2 beyond baseline levels of coping motives in year 1 ($\beta = -0.04$, $p = 0.62$; see Figure 3). There were significant positive cross-lagged relations found between coping motives and weekly marijuana use in years 2 and 3, where coping motives predicted increased weekly marijuana use in year 3 ($\beta = 0.22$, $p < 0.01$) and weekly marijuana use in year 2 predicted increased coping motives in year 3 ($\beta = 0.19$, $p < 0.01$), over and above the level of motives and use in year 2. Over time, the high coefficients for both coping motives ($\beta = 0.57-0.64$, $p < 0.001$) and weekly marijuana use ($\beta = 0.46-0.50$, $p < 0.001$) suggested strong stability, reinforcing the reliability of these constructs.

Significant positive cross-lagged relations between motives and weekly marijuana use across year 2 and 3, replicated for both enhancement ($\beta = 0.09 - 0.23$, $p < 0.05$) and expansion motives ($\beta = 0.23 - 0.25$, $p < 0.001$), suggesting that motives and marijuana use could predict increases in one another over time. However, there were no significant cross-lagged relations between increased social motives and weekly marijuana use. Like alcohol motives,

the strength of marijuana motives' coefficients suggested strong stability over a three-year period ($\beta = 0.47 - 0.67$, $p < 0.001$).

3.3 Exploratory Analyses

Analyses were rerun controlling for gender and age. When accounting for gender, models involving marijuana and motives as well as alcohol and conformity motives displayed the same patterns, though significant negative cross-lagged relations were found between alcohol use and coping motives, where endorsement of motives and use in year 2 predicted lower levels of motives and use in year 3. Models examining alcohol use with social and enhancement motives had poor fit. Controlling for age did not change patterns of cross-lagged relations for alcohol or marijuana use and motives.

4.0 Discussion

The current study examined the cross-lagged relations between alcohol and marijuana use and their respective motives at 3 timepoints across 3 years. Results indicated different trends across the type of substance. For alcohol use, we hypothesized that use would predict increases in social, coping, and enhancement motives over and above baseline levels. Positive cross-lagged relations were indeed found between freshman and sophomore year for social and coping motives, and surprisingly for conformity motives as well, suggesting that motives and alcohol use could predict increases in one another over time. However, significant cross-lagged relations were not found between sophomore and junior year. These results suggest that at the start of college, use of alcohol itself reinforces these motivations to drink, thereby perpetuating this cycle. However, between sophomore and junior year, while social motives, but not coping and conformity motives, continue to predict alcohol use, use itself is no longer a significant force in reinforcing these motives over time. In contrast, enhancement motives demonstrated crosslagged relations with alcohol use across freshman, sophomore, and junior years, suggesting that one's expectations that drinking makes activities more reinforcing perpetuates increased alcohol use, and alcohol use itself maintains and increases these expectations over time.

For marijuana use, results were different. We hypothesized that marijuana use would predict increases in enhancement, expansion, and coping motives. Positive cross-lagged relations were indeed found between increased weekly marijuana use and increased enhancement, expansion, and coping motives between sophomore and junior year, suggesting that marijuana use reinforces these types of motivations to smoke and vice versa. Contrary to hypotheses, although social motives predicted increased future use across all years, in no instance did marijuana use predict increased social motives. Importantly, marijuana conformity motives showed weak relations with other motives and marijuana use, indicating that conformity was a rather ineffective predictor in general.

This study represents an extension of the previous work in multiple ways, including the use of several timepoints to explore interrelations between these constructs, as well as the stability of these constructs over time. Moreover, the theoretical underpinnings of these motives (i.e., towards positive or negative rewards) correspond with biobehavioral reward and stress models of problematic substance use as well as maintenance theories of how

reinforcement may perpetuate the interrelations between motives and use, particularly alcohol use and enhancement motives. Further, based on the magnitude of coefficients, each of the motives demonstrated significant stability metrics across three years in a college population. This suggests that one's motivations for using alcohol or marijuana remain quite consistent across young adulthood years. Lastly, this is the first study to explore these motives across two different forms of substance use, thereby allowing for comparisons of their functioning over time. Result patterns demonstrated an interesting effect; cross-lagged relations were primarily evident for alcohol across freshman and sophomore years and for marijuana use across sophomore and junior years. While we are unable to explore this effect directly, we can consider some hypotheses.

First, we hypothesize that these results may be possible because while motives may be a reason to start drinking/smoking, it takes time and experience with the substance to develop cross-lagged relations. Drinking is a common behavior in adolescence; access to alcohol is high prior to and during freshman year, but access to marijuana is likely to show increases later in college years (SAMHSA, 2015). Prevalence rates reflect these trends, in those aged 12-17 years, 28.4% reported lifetime alcohol use compared to only 15.7% that reported lifetime marijuana use (SAMHSA, 2015). Within our dataset, although we see increases in both alcohol and marijuana average weekly use over three years, there is a more drastic increase in marijuana use (7.77 hits per week in year 1 vs. 11.26 hits per week in year 3) compared to alcohol use (5.05 drinks per week in year 1 vs. 6.56 drinks per week in year 3), further supporting the idea of later increased marijuana use. While this does not account for the decrease in alcohol cross-lagged significance in years 2 to 3, the stabilization of alcohol use may translate into limited variability, thereby reducing our ability to find cross-lagged effects that predict increases in use. Moreover, alcohol may act as a gateway to marijuana use, with participants switching their drug of choice throughout their college experience. This is an empirical question that can be directly explored in future work.

4.1 Implications

These results have specific implications for treatment. Treatment may specifically focus on these motives to interrupt the cycle of substance use. Given the strong relationship between enhancement motives and alcohol use, it is possible that generating alternative coping strategies that are still exciting, but also safe, may be helpful. For example, behavior activation principles may encourage students to engage in more pleasurable and appropriate activities. In terms of coping motives, positive coping strategies, such as mindfulness or exercise, could be suggested to replace substance use as a self-medicating behavior. Behavioral economics can be also helpful for people motivated by potential gains (e.g., expansion, enhancement, social) to learn about potential costs of behavior, thereby increasing the salience of consequences in the moment (Bickel et al., 2014; Bickel, and Marsch, 2001). Lastly, the differing results between alcohol and marijuana strongly suggest that treatment should be tailored based on the substance used, given the differential motives for use and different period of influence of use on reinforcement of motives.

4.2 Limitations and Future Directions

Although the Life History Calendar has been shown to be a reliable method for the collection of this type of data across multiple years (up to 5 years; Caspi et al., 1996), participants' abilities to accurately recollect specific rates and frequencies of use up to twelve months is naturally somewhat diminished. However, the prevalence rates of alcohol (92%) and marijuana use (55%) were like those of national data covering this age range (82% and 53%, respectively, among those ages 18-25; SAMHSA, 2015), suggesting that this methodology was adequate. Future prospective studies could conduct assessments more frequently to overcome the limitations of retrospective reporting. Also, despite being theoretically differentiated, motives were moderately to highly correlated to one another. Therefore, future work may combine motives and examine how such streamlining may affect results.

Another limitation is the narrow breadth of the sample, indicating limited generalizability. Participants were at a large, public, southeastern university, with little racial/ethnic variation. Though a college population represents an important transition period from adolescence into adulthood, particularly in terms of substance use, it is still necessary to investigate other developmental periods. Moreover, motives for use are likely different across racial and ethnic groups, which may impact cross-lagged findings. Therefore, it would be useful to explore cross-lagged relations in a different sample with greater power to investigate these variables. Finally, though the current analytic strategy controlled for previous levels of use in analyses, it did not control for repeated measurements within the same participants. Therefore, other analytic strategies, such as multilevel modeling, may be used in the future to account for repeated measurements. Trajectory analyses may also be informative to determine how groups may follow different pathways related to both motives and substance use over time.

The current study did not address other forms of substance use. Future work could explore the distinct motive relations in hard drug use in populations where this variability is present. Future work could also expand to include different methods of intaking substances. Based on previous work (Schauer et al., 2016) showing that most marijuana users used marijuana in combustible form, the study asked about marijuana use in terms of "hits' or "joints" and did not include edibles. Regardless, future work should include edibles in assessment procedures to ensure that this important work is captured appropriately in data. Finally, the current study overrecruited those at risk for substance use based on conduct disorder symptomatology. Though a large portion of the sample endorsed alcohol or marijuana use, it is possible that results may differ for a sample selected explicitly for alcohol or marijuana use.

5.0 Conclusions

This study explored potential cross-lagged relations between motives and alcohol or marijuana use across the period from freshman to junior year of college. Results indicate that although motives predict increased use, substance use also predicts future increased motives, suggesting that use itself reinforces one's reasons for using, thereby contributing to the intractable cycle of use. We believe that these results are directly translatable into

existing programs through the education of patients regarding this cycle and the use of alternative coping skills and behavioral economics to disrupt the cycle of use prior to the development of addiction.

Acknowledgments

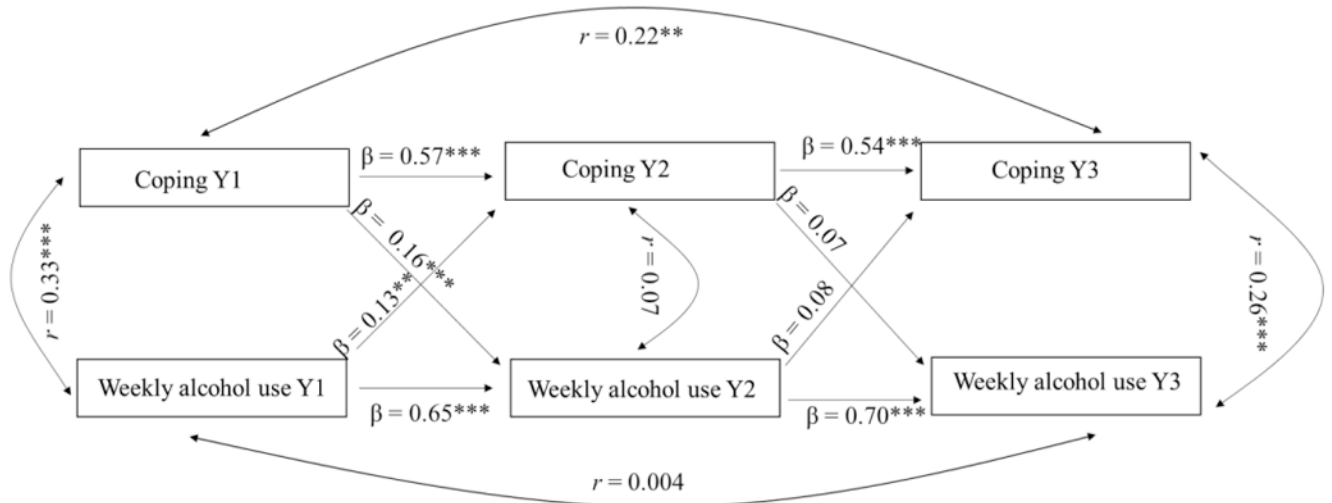## References

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Highlights

- Alcohol and marijuana use and motives studied over 3 years in college students.

- Cross-lagged relations between alcohol use and motives found in year 1 and 2.

- Cross-lagged relations between marijuana use and motives found in year 2 and 3.

- Intervention targets may focus on motives, such as behavior activation.

Figure 1.
Cross-lag relations among weekly alcohol use and coping motives over three years.
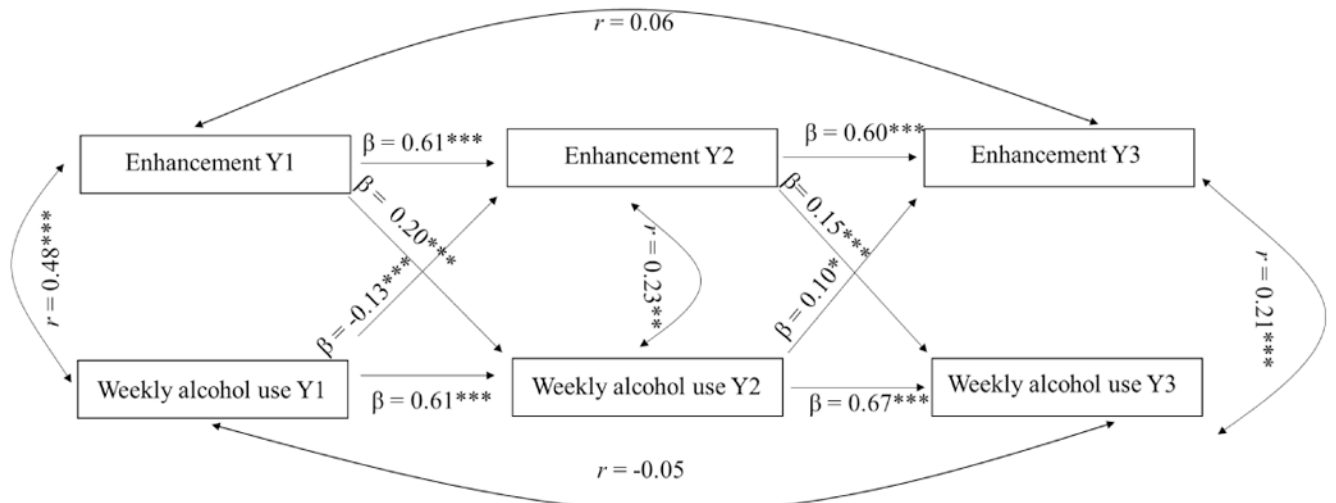
$\chi(2) = 3.23, p = 0.20$; RMSEA = 0.04, CFI = 1, Enhancement Y2 R^2 = 46%, Weekly alcohol use Y2 R^2 = 53%, Enhancement Y3 R^2 = 47%, Weekly alcohol use Y3 R^2 = 54%

Figure 2.
Cross-lag relations among weekly alcohol use and enhancement motives over three years.
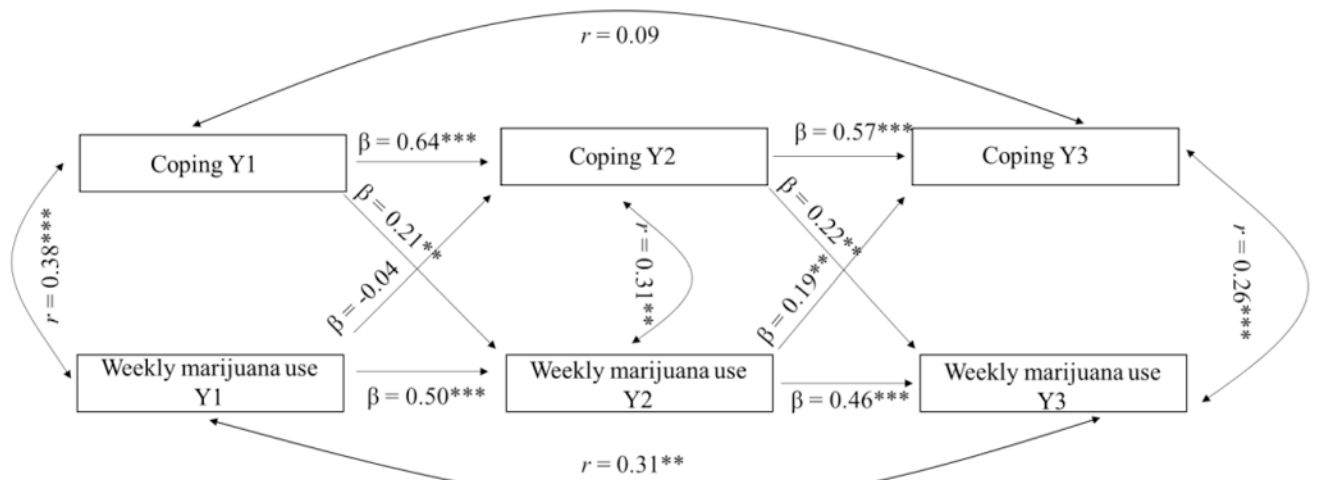
χ(2) = 0.48, p = 0.79; RMSEA = 0, CFI = 1, Coping Y2 R^2 = 39%, Weekly marijuana use Y2 R^2 = 36%, Coping Y3 R^2 = 51%, Weekly marijuana use Y3 R^2 = 44%

Figure 3.
Cross-lag relations among weekly marijuana use and coping motives over three years.

Table 1

Descriptive Statistics

	Year 1		Year 2		Year 3	
	Mean	SD	Mean	SD	Mean	SD
DMQ: Coping	2.33	1.04	2.26	1.09	2.29	1.09
DMQ: Social	3.53	1.22	3.65	1.19	3.71	1.16
DMQ: Enhancement	3.07	1.17	3.16	1.13	3.16	1.13
DMQ: Conformity	1.88	0.83	1.88	0.87	1.83	0.89
Weekly alcohol use	5.05	6.61	6.28	7.67	6.56	7.85
MMQ: Coping	1.65	0.86	1.76	0.87	1.79	0.91
MMQ: Social	2.04	1.15	2.19	1.02	2.19	1.05
MMQ: Enhancement	2.70	1.44	2.89	1.32	2.84	1.34
MMQ: Conformity	1.32	0.57	1.38	0.51	1.36	0.53
MMQ: Expansion	1.75	1.01	1.96	1.15	1.95	1.12
Weekly marijuana use	7.77	21.51	9.41	21.81	11.26	24.32

Min. = Minimum, Max. = Maximum, DMQ = Drinking Motives Questionnaire, MMQ = Marijuana Motives Questionnaire. Weekly Alcohol Use = Average number of drinks per week. Weekly Marijuana Use = Average number of hits per week.

Table 2

Correlations among Weekly Alcohol Use and Motives

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Year 1 Data														
1. Motives: Coping	1													
2. Motives: Social	0.57***	1												
3. Motives: Enhancement	0.57***	0.94***	1											
4. Motives: Conformity	0.40***	0.38***	0.29***	1										
5. Weekly Alcohol Use	0.34***	0.44***	0.48***	0.11*	1									
Year 2 Data														
1. Motives: Coping	0.61***	0.37***	0.39***	0.22***	0.34***	1								
2. Motives: Social	0.39***	0.61***	0.59***	0.17**	0.39***	0.54***	1							
3. Motives: Enhancement	0.43***	0.58***	0.67***	0.13*	0.43***	0.55***	0.83***	1						
4. Motives: Conformity	0.22***	0.17**	0.18***	0.45***	0.20***	0.36***	0.35***	0.27***	1					
5. Weekly Alcohol Use	0.39***	0.49***	0.50***	0.15**	0.71***	0.36***	0.45***	0.52***	0.13*	1				
Year 3 Data														
1. Motives: Coping	0.55***	0.35***	0.40***	0.17**	0.27***	0.67***	0.42***	0.45***	0.19**	0.33***	1			
2. Motives: Social	0.32***	0.43***	0.44***	0.16**	0.32***	0.41***	0.65***	0.57***	0.28***	0.34***	0.55***	1		
3. Motives: Enhancement	0.35***	0.40***	0.53***	0.13*	0.36***	0.43***	0.60***	0.69***	0.23***	0.43***	0.61***	0.75***	1	
4. Motives: Conformity	0.20***	0.17***	0.22***	0.39***	0.17**	0.19**	0.21***	0.19***	0.50***	0.14**	0.41***	0.40***	0.33***	1
5. Weekly Alcohol Use	0.31***	0.42***	0.47***	0.13*	0.52***	0.35***	0.44***	0.50***	0.18*	0.72***	0.42***	0.41***	0.50***	0.24***

*
$p<0.05$,

**
$p<0.01$,

***
$p<0.001$.

Weekly Alcohol Use = Average number of drinks per week.

Table 3

Correlations among Weekly Marijuana Use and Motives

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Year 1 Data																	
1. Motives : Coping	1																
2. Motives : Social	0.67 ***	1															
3. Motives : Enhancement	0.68 ***	0.83 ***	1														
4. Motives : Conformity	0.42 ***	0.38 ***	0.37 ***	1													
5. Motives : Expansion	0.63 ***	0.64 ***	0.71 ***	0.28 ***	1												
6. Weekly marijuana use	0.38 ***	0.48 ***	0.41 ***	0.09	0.33 ***	1											
Year 2 Data																	
7. Motives : Coping	0.61 ***	0.40 ***	0.43 ***	0.34 ***	0.43 ***	0.19 *	1										
8. Motives : Social	0.36 ***	0.43 ***	0.36 ***	0.32 ***	0.34 ***	0.18	0.63 ***	1									
9. Motives : Enhancement	0.38 ***	0.42 ***	0.47 ***	0.24 ***	0.41 ***	0.22 **	0.63 ***	0.78 ***	1								
10. Motives : Conformity	0.21 **	0.08	0.43 ***	0.47 ***	0.08	0.01	0.29 ***	0.27 ***	0.19 **	1							
11. Motives : Expansion	0.37 ***	0.40 ***	0.39 ***	0.28 ***	0.60 ***	0.14 *	0.63 ***	0.64 ***	0.66 ***	0.22 **	1						
12. Weekly marijuana use	0.38 ***	0.39 ***	0.38 ***	0.11	0.34 ***	0.57 ***	0.38 ***	0.39 ***	0.41 ***	-0.01	0.37 ***	1					

Year 3 Data

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
13. Motives : Coping	0.46 ***	0.25 ***	0.30 ***	0.14 *	0.30 ***	0.22 **	0.67 ***	0.54 ***	0.58 ***	0.06	0.48 ***	0.44 ***	1				
14. Motives : Social	0.32 ***	0.30 ***	0.25 ***	0.19 **	0.18 *	0.22 *	0.44 ***	0.59 ***	0.55 ***	0.03	0.39 ***	0.33 ***	0.71 ***	1			
15. Motives : Enhancement	0.33 ***	0.28 ***	0.36 ***	0.20 ***	0.25 ***	0.24 **	0.47 ***	0.57 ***	0.71 ***	0.03	0.47 ***	0.38 ***	0.71 ***	0.76 ***	1		
16. Motives : Conformity	0.14	0.04	0.04	0.31 **	-0.02	-0.10 *	0.08	0.09	0.07	0.41 ***	0.10	-0.08	0.28 ***	0.31 ***	0.22 ***	1	
17. Motives : Expansion	0.29 ***	0.27 ***	0.29 ***	0.09	0.40 ***	0.17 *	0.50 ***	0.51 ***	0.60 ***	0.04	0.68 ***	0.48 ***	0.66 ***	0.54 ***	0.65 ***	0.15 *	1
18. Weekly marijuana use	0.32 ***	0.22 **	0.24 **	0.13	0.25 **	0.51 ***	0.36 ***	0.38 ***	0.39 ***	0.12	0.37 ***	0.65 ***	0.47 ***	0.46 ***	0.44 ***	-0.01	0.49 ***

*
$p<0.05$,

**
$p<0.01$,

***
$p<0.001$.

Weekly Marijuana Use = Average number of hits per week