

Alcohol and Marijuana use in Undergraduate Males: Between- and Within-Person Associations with Interpersonal Conflict

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ABSTRACT

Among college students, interpersonal conflict with others is a common, yet stressful negative interpersonal experience. Research suggests that drinking episodes may contribute to the occurrence of conflict. Marijuana use, independently or in conjunction with alcohol, may also influence the likelihood of subsequent conflict. We considered the temporal effects of independent and simultaneous alcohol and marijuana use episodes on the occurrence of interpersonal conflict. Use of multilevel modeling allowed us to distinguish the within-person effects of substance use from between-person differences in frequency of use. Within a sample of 427 college freshman males over 56 days of daily reports, we examined the independent and interactive effects of episodes of alcohol and marijuana on the odds of conflict within the next 1-, 2-, 3-, and 4 hours. Multilevel modeling analyses showed that drinking episodes increased the likelihood of conflict occurring within the next 1-, 2-, 3-, and 4 hours. Marijuana had weaker positive effects, significant only within the 2-hour window. There were no alcohol by marijuana interaction effects in any analysis. Both marijuana and alcohol independently increased the likelihood of interpersonal conflict; however, the marijuana effect appeared less robust. As marijuana use becomes more normative and accessible for college students, it is important to understand the extent to which marijuana use results in negative consequences and the contexts under which these effects unfold.

Key words: marijuana, alcohol, college students, daily diary, interpersonal conflict

Heavy alcohol use and marijuana use have been associated with increased social, psychological, and physiological negative consequences (e.g., Graham et al. 2011; Volkow, Baler, Compton, & Weiss, 2014). Among potential consequences of substance use, interpersonal conflict is a common, yet stressful negative interpersonal experience among college students (Robertson, Forbes, & Thyne, 2017). Interpersonal conflict consists of an interaction involving negative emotion and disagreement or

interference with the attainment of one or both persons' goals (Barki & Hartwick, 2001, 2004; Fink, 1968). It may include verbal or physical aggression (Anderson & Bushman, 2002). Studies using laboratory (e.g., Eckhardt & Crane, 2008; Duke, Giancola, Morris, Holt, & Gunn, 2011), field (e.g., Graham, Bernards, Osgood, & Wells, 2006), and daily process (e.g., Miller, Quigley, Eliseo-Arras, & Ball, 2016) methods provide evidence that acute alcohol use increases the likelihood of interpersonal conflict and verbal aggression.

Alcohol use is thought to contribute to interpersonal conflict and aggression due to its pharmacological effects: impaired cognitive functioning (Giancola, 2000), increased physiological arousal (Conrod, Peterson, & Pihl, 2001), and heightened attention to salient, provoking cues (Steele & Josephs, 1990; Taylor & Leonard, 1983). Marijuana may independently contribute to the occurrence of conflict or potentiate alcohol's effect on aggression; however, evidence is limited. Associations between marijuana and conflict may also reflect confounding individual difference variables associated with aggression or concurrent alcohol use rather than acute effects of marijuana. In the present study, we used daily process methods to disaggregate within-person or temporal effects of alcohol and marijuana use on interpersonal conflict from between-person effects.

Marijuana, Aggression, and Interpersonal Conflict

Marijuana is used by approximately one-third of college students (Miech, Johnston, O'Malley, Bachman, & Schulenberg, 2015; Suerken et al., 2014), often in conjunction with alcohol (Mallett et al., 2017; Terry-McElrath, O'Malley, & Johnston, 2013). Although marijuana is typically considered benign and associated with relaxation (Okaneke, Vearrier, McKeever, LaSala, & Greenberg, 2015; Pearson et al., 2017; Schuermeyer et al., 2014), its acute effects also include increased anxiety, arousal, confusion, heart rate, and perceptual distortion, which may increase the likelihood of conflict following its use (e.g., Hunault et al., 2014). For example, marijuana users reported greater perceived hostility in others on days of marijuana use compared to days of no use, controlling for both within-day alcohol use and average drinking days during the study period (Ansell, Laws, Roche, & Sinha, 2015). Trull and colleagues found complex associations between marijuana use and hostility after accounting for alcohol use. Marijuana use was associated with increased hostility at the momentary level. At the between-person level, more frequent marijuana users were more likely to report higher levels of hostility, and lagged marijuana use was associated with decreased hostility, suggesting that participants may have been using marijuana to decrease feelings of hostility (Trull et al., 2016).

Marijuana use days (versus days of no use) were also associated with increased impulsivity (Trull et al., 2016). These two investigations suggest that marijuana use is associated with hostile feelings and attributions toward others and is proximally associated with impulsive behavior. In addition, some (e.g., Epstein-Ngo et al., 2014; Shorey, Stuart, McNulty, & Moore, 2014) though not all daily report studies (e.g., Moore et al., 2011; Epstein-Ngo et al., 2013) find positive temporal effects of marijuana on perpetration of aggression. In a recent EMA study of marijuana-using couples, there was a positive temporal effect of marijuana episodes on self-reported episodes of conflict and verbal aggression toward one's intimate partner after accounting for drinking episodes (Testa et al., 2018).

Alcohol, Aggression, and Interpersonal Conflict

There is well-established evidence for a positive temporal effect of drinking on subsequent conflict and aggression (e.g., Ito, Miller, & Pollock, 1996). In a 30-day daily report study of college students, Neal and Fromme (2007) found that aggressive behavior was more likely to occur on days in which a student reached a daily blood alcohol concentration (BAC) higher than their 30-day average. Analyses were conducted to ensure that drinking took place prior to aggression, facilitating the interpretation that drinking contributed to later conflict. Robertson et al. (2017) assessed whether college students differed in the likelihood of experiencing different types of aggressive behavior (anger, verbal, physical, and relational aggression) on drinking days as compared to non-drinking days. Most types of aggression were more likely to occur on drinking days than on non-drinking days, and students who drank more heavily were likely to perpetrate more verbal and physical aggression when drinking. However, alcohol events did not increase the odds of all aggressive acts. For example, while women and men reported more verbal and physical aggression on drinking days, men did not report differences in anger following drinking days.

Simultaneous Use of Marijuana and Alcohol

Alcohol use is thought to contribute to interpersonal conflict due to its impairment of

cognitive functioning, particularly in persons predisposed to aggression and/or in situations with strong aggressive cues (Giancola et al., 2012; Steele & Josephs, 1990; Taylor & Leonard, 1983). Cross-sectional survey research suggests that people who use alcohol and marijuana together experience more negative consequences compared to users of either drug alone, including increased quantity and frequency of alcohol use (Midanik, Tam, & Weisner, 2007; Subbaraman & Kerr, 2015). The pharmacological effects of alcohol may be exacerbated when consumed simultaneously with marijuana (Lee, Cadigan, & Patrick, 2017; Terry-McElrath, O'Malley, & Johnston, 2013). Alcohol effects (i.e., "dizzy, clumsy, confused") were higher during simultaneous use episodes than during episodes of only alcohol use; however, the effects of "high" and "feeling marijuana effects" were lower during simultaneous use episodes than during marijuana use only episodes. Drinks and time spent high interacted to predict greater simultaneous use effects such that for those who spent less time high, drinks were associated with increased effects of simultaneous alcohol and marijuana use (Lee, Cadigan, & Patrick, 2017).

If alcohol effects are exacerbated during simultaneous use, then these greater alcohol effects have the potential to increase likelihood of negative social consequences such as fighting and relationship problems. Adolescent male simultaneous use predicted the occurrence of non-dating violence, but not dating violence (Epstein-Ngo et al., 2014). College students who used alcohol in combination with other substances (including marijuana) were more likely to experience negative consequences (e.g., drinking more than they planned, doing something embarrassing, saying harsh/cruel things) than students who used alcohol only (Mallett et al., 2017).

Rationale and Current Hypotheses

In the present study, we used intensive longitudinal methods to examine the between- and within-person effects of alcohol and marijuana use on interpersonal conflict. Our primary hypothesis was that alcohol and marijuana use would each increase the odds of interpersonal conflict occurring within the next several hours. Prior research on the temporal

effects of alcohol consumption has considered its effects within 3-4 hour windows, which approximates the average length of time that pharmacological effects of alcohol are thought to last (Testa & Derrick, 2014; Testa et al., 2015). Marijuana effects are thought to peak around 30 minutes after use and decline after 2-3 hours (Grotenhermen, 2003), suggesting peak effects within a somewhat shorter window of time. We conducted analyses using 1-, 2-, 3-, and 4-hour windows to consider the extent to which alcohol and marijuana effects on interpersonal conflict varied depending on time. In addition, we considered whether simultaneous alcohol and marijuana use, operationalized as the interaction of alcohol and marijuana use, had a unique, temporal effect on interpersonal conflict.

We used multilevel modeling to distinguish these hypothesized within-person effects from any between-person effects. Within-person effects of alcohol and marijuana on interpersonal conflict suggest an acute effect of the substance or the substance use environment on the likelihood of interpersonal conflict. In contrast, between-person effects suggest that individual differences in substance use or personality increase the likelihood of interpersonal conflict. Because delinquency is likely to be associated with conflict and substance use (Ferguson & Meehan, 2011), we also included delinquency as a between-person predictor, hypothesizing that college males with higher than average levels of delinquent behavior would be more likely to report conflict on a given day. Exploratory cross-level interactions between substance use and delinquency were also considered as predictors of interpersonal conflict, allowing us to consider whether the effects of alcohol or marijuana on conflict were stronger for men predisposed toward aggression.

METHOD

Participants and Recruitment

Participants ($N = 427$) were selected from a larger sample of freshman males who entered a large public Northeastern university in the fall of 2011 or 2012, were 18 or 19 years of age and participated in a survey study at the end of their first semester ($N = 2,037$). Eligibility criteria for the daily report study were designed to yield a sample of men likely to report drinking and

engaging in sexual activity during the 56-day reporting period (see Testa et al., 2015 for recruitment details). Fall survey responses were used to identify men who: 1) drank 5 or more drinks on one occasion at least twice per month or drank weekly and 2) had a “hookup” or sexual intercourse with a woman at least once in the first semester or 3) who reported perpetrating sexual aggression on either the Sexual Experiences Survey (Koss et al., 2007) or the Sexual Strategies Survey (Strang, Peterson, Hill, & Heiman, 2013). Men who completed the daily report study ($N = 427$) were compared to those who were invited but did not participate ($N = 337$) on history of delinquency and sexual aggression, frequency of heavy episodic drinking, frequency of any alcohol use, and frequency/quantity of marijuana use in their first semester of college. Those who were eligible but did not participate reported a higher frequency of past-semester marijuana use ($M = 8.91$, $SD = 10.69$) than those who participated in the diary study ($M = 7.21$, $SD = 9.54$), $t(679.459) = 2.287$, $p = .02$. The groups did not differ on the rest of the aforementioned variables. Characteristics of the sample are provided in Table 1.

Table 1. *Sample Characteristics (N = 427)*

Variable	N, %
First Semester Heavy Episodic Drinking	397 (93.0)
First Semester Marijuana Use	252 (59.0)
Race	
European-American	324 (75.9)
Asian-American	45 (10.5)
African-American	19 (4.4)
Native American	3 (.7)
Other/Mixed Race	28 (.9)
Hispanic	32 (7.5)
Sexual Orientation	
Heterosexual	413 (96.7)
Bisexual or Questioning	6 (1.4)
Homosexual	8 (1.9)
Lived During School Year	
Dormitory	319 (74.7)
With Parents/Relatives	102 (23.9)
Off Campus Apartment	6 (1.4)

Procedures

Participants provided online consent before completing the fall baseline survey and also before completing the first day's report in the daily report study. For the next 55 days, participants received email reminders at 9 AM containing a link to the daily report. If they missed one day of reporting, they were allowed to complete an abbreviated make-up report for that day after completing the current day's report. Omission of more than one day triggered a phone call by project staff to determine whether there were any difficulties and to encourage continued reporting. Daily surveys took no more than 5 minutes to complete. Participants were compensated with Campus Cash as follows: \$10 for each complete week (6/7 reports) and a \$40 bonus for completing all 8 weeks (maximum \$120). All procedures were approved by the investigators' university Social and Behavior Sciences Institutional Review Board.

Measures

Substance Use. For each daily report, men were asked “at any time since yesterday have you consumed any alcohol?”, using a dichotomous response option (0 = No; 1 = Yes). For each episode, participants reported the hour that drinking started, permitting temporal ordering of alcohol use and interpersonal conflict episodes. They were also asked how many drinks they consumed. The same questions were asked regarding marijuana use: “At any time since yesterday have you consumed any marijuana?” (0 = No; 1 = Yes). As with alcohol, participants reported the hour that marijuana use started and how high they felt on a 7-point Likert scale (1 = Not at High; 7 = Extremely High).

Interpersonal Conflict. For each daily report, men were asked “at any time since yesterday did you have an argument, fight, or angry disagreement with someone?” using a dichotomous (0 = No; 1 = Yes) response option. Participants also indicated the hour that this interpersonal conflict occurred.

Delinquency. At baseline, delinquency was assessed with the Antisocial Behavior Checklist, Adolescent version (Zucker, 2005). This measure included 18 items (e.g., skipped school, took part in gang fight) rated on a 4-point scale ranging

from 0 (never) to 3 (often, 10 or more times in life). Responses were summed. This measure showed good reliability, $\alpha = .80$.

Data Analyses

The following analyses were designed to determine whether alcohol and marijuana use reported daily, as well as their interaction, increased the likelihood of interpersonal conflict. We conducted these analyses over several time windows designed to reflect the time frame of alcohol and marijuana's pharmacological effects. Analyses were conducted using multilevel logistic regression modeling with two levels and random intercepts in *Mplus* Version 7.4 (Muthén & Muthén, 1998-2015) using maximum likelihood estimation with robust standard errors. At Level 1, we entered alcohol and marijuana use. In order to compute the temporal version of the predictors, we divided each day into 24 one-hour segments. We then created lags for the predictor variables within, for example, the previous hour and collapsed across those lagged variables to create "moving windows" that included any instances of alcohol and marijuana use in the previous 1 hour. We repeated this using 2-, 3-, and 4- hour windows. Alcohol and marijuana use were uncentered binary variables. We created an interaction term (alcohol X marijuana) to consider the effect of alcohol and marijuana occurring within the same time window use on interpersonal conflict. We also included weekend

(0 = weekday, Monday - Thursday; 1 = weekend; uncentered), given that substance use and potentially interpersonal conflicts are more likely to occur on weekends (Testa et al. 2015; Wood, Sher, & Rutledge, 2007). We also modeled at Level 1 the effect of study day (1-56), since reporting of events typically decreases over time in daily designs (Testa et al. 2015). The day of study was grand mean centered. At Level 2, we controlled for each participant's total days of only alcohol, only marijuana, and use of both alcohol and marijuana use over the study period to distinguish within-person from between-person effects. We also considered the effects of delinquent behavior at Level 2, as well as its cross-level interaction with alcohol and marijuana. Level 2 variables were grand mean centered.

RESULTS

Descriptive Data

Participants ($N = 427$) completed a total of 20,366 daily reports over 56 days (85.2% of all possible days). Men reported 2,284 days of alcohol use (11% of total days), 1,735 days (8.5%) of marijuana use, and 502 days (2.5% of total days) on which both substances were used. Characteristics of marijuana and alcohol use events are reported in Table 2. Interpersonal conflicts were reported on 979 days (4.8% of total days). Of days on which conflicts were reported,

Table 2. *Characteristics of Substance Use Events*

Variable	Alcohol Episodes ($N = 2,284$)	Marijuana Episodes ($N = 1,735$)
Number of people present	(M, SD)	(M, SD)
Men	6.59 (9.36)	2.25 (2.17)
Women	4.78 (8.62)	0.68 (1.88)
	(n, %)	(n, %)
Weekend	1,508 (66.0%)	561 (32.3%)
Occurred between 8pm-12am	1,789 (78.3)	973 (56.1%)
Preceded a conflict episode	139 (6.1%)	90 (5.2%)
Within 4 hours	67 (2.9%)	27 (1.6%)
Within 3 hours	54 (2.4%)	21 (1.2%)
Within 2 hours	35 (1.5%)	15 (0.9%)
Within 1 hour	18 (0.8%)	8 (0.7%)

Note. Alcohol and marijuana use episodes were examined separately; Weekend = Friday and Saturday.

214 (21%) also included alcohol and 156 (15%) also included marijuana. Few conflicts were reported as occurring at the same time as marijuana ($n = 12$, 1.2%) or alcohol use ($n = 13$, 1.3%). Because temporal ordering could not be determined in these instances, these events were treated as zeros and thus not included in the final analyses.

Substance Use and Subsequent Interpersonal Conflicts

We examined whether alcohol and marijuana use increased the likelihood of conflict occurring within the next 1, 2, 3, and 4 hours. As Table 3 shows, alcohol was positively and significantly associated with conflict at all four time windows (ORs = 2.587 - 3.474, all $p < .001$). Marijuana use was also positively associated with conflict (ORs = 2.009 - 1.681, all $p < .10$), but the effect reached the statistical significant level only in the 2-hour time window (OR = 2.024; $p < .05$). The interaction between alcohol and marijuana use did not contribute independently to prediction of conflict for any time window. Not surprisingly, for all time windows, conflict was more likely to occur on the weekends ($p < .05$) and reports declined over 56 days ($p < .001$), consistent with other daily report studies showing a decline in reporting over time (Testa et al. 2015).

Regarding between-person effects on interpersonal conflict, men who reported more alcohol use only days over 56 days were more likely to report conflict in a given hour ($p < .05$). Neither the number of marijuana use days nor use of alcohol and marijuana days reported across the study period increased the odds of reporting interpersonal conflict. Contrary to expectations, men reporting more delinquent behavior were not more likely to report conflict in a given hour. We also considered the cross-level interaction between delinquent behavior and marijuana, as well as delinquency by alcohol use. These interactions were non-significant in all models, and subsequently dropped from these analyses.

We conducted two separate analyses replacing any alcohol use with number of drinks as a main effect. First, we added an interaction between number of drinks and marijuana use (see Table 4). In the second we replaced the dichotomous variable marijuana use with report of subjective "high" (see Table 5). We also added an interaction between number of drinks and marijuana use

high. The models were highly similar to the original dichotomous models, except that the marijuana high effects were significant in the 2-, 3-, and 4-hour analyses. The drinks by marijuana interactions were not significant in either model.

DISCUSSION

Previous research suggests that alcohol use has a proximal effect on subsequent interpersonal conflict and verbal aggression (e.g., Epstein-Ngo et al., 2014; Neal & Fromme, 2007). We replicated this effect, finding that the positive effects of alcohol use on conflict were robust, emerging regardless of whether we used a 1-, 2-, 3-, or 4-hour time window. We found some evidence for positive effects of marijuana use episodes on conflict, as well as a robust effect of subjective marijuana high on later interpersonal conflict.

In contrast to hypotheses, we found no evidence for an interaction between marijuana use and alcohol on interpersonal conflict, suggesting that simultaneous use of these substances does not increase the likelihood of interpersonal conflict beyond use of either substance independently. Moreover, we failed to find a Level 2 effect of alcohol and marijuana use on odds of conflict. These findings do not negate emerging literature suggesting that simultaneous users experience particularly deleterious consequences, but rather may indicate that interpersonal conflict is not sensitive to these effects. It is important for these analyses to undergo replication to understand the extent to which marijuana use results in negative consequences and the contexts under which these effects unfold, particularly as marijuana use becomes more normative and accessible for college students.

Several prior studies found no independent event-level associations between marijuana and conflict or aggression (Moore et al., 2011; Shorey et al., 2014; Stoddard et al., 2015); however, our methods differed in several ways. First, some of these investigations relied on well-validated Timeline Follow Back methods (e.g., Stoddard et al., 2015). These methods, while using a calendar visual aid, are still retrospective rather than prospective or concurrent reports and rely heavily on the participant's ability to accurately report the (co)occurrence of substance use and interpersonal conflict or aggressive behaviors.

Table 3. Association between Substance Use and Subsequent Likelihood of Interpersonal Conflict 1 through 4 Hours Later

Variable	1 Hour Later		2 Hours Later		3 Hours Later		4 Hours Later	
<i>Within-level</i>	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
ALC use	2.587***	[1.301, 5.142]	3.328***	[2.047, 5.409]	3.331***	[2.148, 5.165]	3.474***	[2.358, 5.118]
MJ use	2.009+	[0.940, 4.296]	2.024*	[1.149, 3.565]	1.699+	[0.987, 2.924]	1.681+	[0.983, 2.873]
ALC × MJ	0.000^	[0.000, 0.000]	0.255	[0.029, 2.240]	0.494	[0.121, 2.019]	0.527	[0.163, 1.709]
Weekend	1.432*	[1.091, 1.879]	1.381*	[1.059, 1.799]	1.350*	[1.035, 1.762]	1.322*	[1.020, 1.714]
Study day	0.974***	[0.966, 0.983]	0.975***	[0.966, 0.983]	0.975***	[0.966, 0.983]	0.975***	[0.967, 0.983]
<i>Between-level</i>	B (S.E.)	95% CI	B (S.E.)	95% CI	B (S.E.)	95% CI	B (S.E.)	95% CI
Delinquency	0.006 (0.015)	[-0.024, 0.036]	0.006 (0.015)	[-0.024, 0.036]	0.006 (0.015)	[-0.024, 0.036]	0.005 (0.015)	[-0.025, 0.035]
ALC days	0.069 (0.026)*	[0.018, 0.120]	0.067 (0.026)*	[0.015, 0.118]	0.065 (0.026)*	[0.014, 0.116]	0.064 (0.026)*	[0.013, 0.114]
MJ days	0.022 (0.016)	[-0.008, 0.053]	0.022 (0.016)	[-0.009, 0.052]	0.022 (0.016)	[-0.009, 0.053]	0.021 (0.016)	[-0.010, 0.053]
ALC+MJ Days	-0.002 (0.038)	[-0.078, 0.073]	-0.006 (0.039)	[-0.081, 0.070]	-0.007 (0.039)	[-0.083, 0.068]	-0.009 (0.039)	[-0.085, 0.067]

Note. OR = Odds Ratio; B = Unstandardized beta; ALC = Alcohol, MJ = Marijuana; *** $p < .001$; ** $p < .01$; * $p < .05$; + $p < .10$; ^ parameter was fixed to avoid the singularity of the information matrix.

Table 4. Association between Drinks, Marijuana Use and Subsequent Likelihood of Interpersonal Conflict 1 through 4 Hours Later

Variable	1 Hour Later		2 Hours Later		3 Hours Later		4 Hours Later	
<i>Within-level</i>	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
ALC use amount	1.045+	[0.992, 1.102]	1.069***	[1.026, 1.113]	1.074***	[1.037, 1.111]	1.082***	[1.048, 1.117]
MJ use	1.986+	[0.930, 4.244]	1.902*	[1.095, 3.304]	1.646*	[1.001, 2.705]	1.658*	[1.030, 2.667]
ALC × MJ	0.000^	[0.000, 0.000]	0.963	[0.798, 1.162]	0.993	[0.897, 1.099]	0.985	[0.907, 1.071]
Weekend	1.450**	[1.109, 1.897]	1.414*	[1.088, 1.838]	1.386*	[1.065, 1.804]	1.354*	[1.048, 1.748]
Study day	0.974***	[0.966, 0.983]	0.974***	[0.966, 0.983]	0.974***	[0.966, 0.983]	0.974***	[0.966, 0.983]
<i>Between-level</i>	B (S.E.)	95% CI	B (S.E.)	95% CI	B (S.E.)	95% CI	B (S.E.)	95% CI
Delinquency	0.006 (0.015)	[-0.024, 0.036]	0.005 (0.015)	[-0.025, 0.035]	0.004 (0.015)	[-0.026, 0.034]	0.003 (0.015)	[-0.027, 0.033]
ALC days	0.069 (0.026)**	[0.018, 0.121]	0.068 (0.026)*	[0.016, 0.120]	0.066 (0.026)*	[0.015, 0.118]	0.064 (0.026)*	[0.013, 0.116]
MJ days	0.022 (0.016)	[-0.009, 0.053]	0.022 (0.016)	[-0.009, 0.052]	0.022 (0.016)	[-0.009, 0.053]	0.022 (0.016)	[-0.009, 0.053]
ALC+MJ days	-0.002 (0.038)	[-0.077, 0.074]	-0.003 (0.038)	[-0.079, 0.072]	-0.005 (0.038)	[-0.081, 0.070]	-0.007 (0.038)	[-0.083, 0.068]

Note. OR = Odds Ratio; B = Unstandardized beta; ALC = Alcohol, MJ = Marijuana; *** $p < .001$; ** $p < .01$; * $p < .05$; + $p < .10$; ^ parameter was fixed to avoid the singularity of the information matrix.

Table 5. Association between Drinks, Marijuana “High”, and Subsequent Likelihood of Interpersonal Conflict 1 through 4 Hours Later

Variable	1 Hour Later		2 Hours Later		3 Hours Later		4 Hours Later	
<i>Within-level</i>	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
ALC use amount	1.045+	[0.992, 1.102]	1.069***	[1.026, 1.113]	1.074***	[1.037, 1.111]	1.082***	[1.048, 1.117]
MJ use	1.986+	[0.930, 4.244]	1.902*	[1.095, 3.304]	1.646*	[1.001, 2.705]	1.658*	[1.030, 2.667]
ALC × MJ	0.000^	[0.000, 0.000]	0.963	[0.798, 1.162]	0.993	[0.897, 1.099]	0.985	[0.907, 1.071]
Weekend	1.450**	[1.109, 1.897]	1.414*	[1.088, 1.838]	1.386*	[1.065, 1.804]	1.354*	[1.048, 1.748]
Study day	0.974***	[0.966, 0.983]	0.974***	[0.966, 0.983]	0.974***	[0.966, 0.983]	0.974***	[0.966, 0.983]
<i>Between-level</i>	B (S.E.)	95% CI	B (S.E.)	95% CI	B (S.E.)	95% CI	B (S.E.)	95% CI
Delinquency	0.006 (0.015)	[-0.024, 0.036]	0.005 (0.015)	[-0.025, 0.035]	0.004 (0.015)	[-0.026, 0.034]	0.003 (0.015)	[-0.027, 0.033]
ALC days	0.069 (0.026)**	[0.018, 0.121]	0.068 (0.026)*	[0.016, 0.120]	0.066 (0.026)*	[0.015, 0.118]	0.064 (0.026)*	[0.013, 0.116]
MJ days	0.022 (0.016)	[-0.009, 0.053]	0.022 (0.016)	[-0.009, 0.052]	0.022 (0.016)	[-0.009, 0.053]	0.022 (0.016)	[-0.009, 0.053]
ALC+MJ days	-0.002 (0.038)	[-0.077, 0.074]	-0.003 (0.038)	[-0.079, 0.072]	-0.005 (0.038)	[-0.081, 0.070]	-0.007 (0.038)	[-0.083, 0.068]

Note. OR = Odds Ratio; B = Unstandardized beta; ALC = Alcohol, MJ = Marijuana; *** $p < .001$; ** $p < .01$; * $p < .05$; + $p < .10$; ^ parameter was fixed to avoid the singularity of the information matrix.

These investigations also only reported dichotomous marijuana use, rather than marijuana use quantity or intensity of subjective marijuana effects. Moreover, none of these investigations designate a specific time window during which marijuana may lead to conflict or aggression. Instead, either same-day or substance use occurring later in the day are used to predict conflict. Using a 2-hour window may reflect acute effects of marijuana, though replication of these findings are needed.

Theory is scant, though recent research suggests that simultaneous use of alcohol and marijuana result in increased consequences beyond use of either drug alone (e.g., Hayaki, Anderson, & Stein, 2016), potentially due to its enhancement of alcohol effects. We did not find an increase in interpersonal conflict following simultaneous use. This may be due to unique features of this sample. Other investigators have found that participants with lower educational attainment, non-white ethnicity, and who are non-partnered are more likely to simultaneously use alcohol and marijuana (Midanik, Tam, & Weisner, 2007; Subbaraman & Kerr, 2015). Approximately 33% of this sample was in a relationship at the beginning of the study period. A low percentage of this sample was nonwhite, as well. Other investigators found greater perceived simultaneous use acute effects in women (Lee et al., 2017). Young men in college may use alcohol and marijuana in a way that does not increase their risk for negative social consequences. For example, there may be risks for non-college attending young adults not relevant to this sample, particularly increased use of marijuana on weekdays. In a broader sample selected specifically for their levels of alcohol and marijuana use, there may be a wider range of negative consequences uniquely associated with simultaneous alcohol-marijuana use. Notably, though men who drank more frequently reported more conflicts, increased number of simultaneous use days (or marijuana use days) did not increase the likelihood of conflicts.

Contrary to hypotheses, delinquency was unassociated with reporting conflict following alcohol and marijuana use nor did it interact with substance use. Daily interpersonal conflicts may not be particularly sensitive to tendencies toward delinquency among a sample of college men. Also, because men were chosen for participation

because of their higher than average levels of drinking, delinquency scores are higher than in an unselected sample, potentially inhibiting our ability to test theoretically-derived predictions due to a truncated range of scores (see Testa et al., 2015).

Limitations

Strengths of this study include a large sample with excellent compliance with the daily protocol. Recording of the timing of events allowed us to precisely model the temporal associations between substance use and conflict over 56 days. However, there are limitations. Daily assessment still involves some retrospection. In this study, college men typically reported substance use and conflict the next day; this could have led to less precise reporting of the timing of substance use and interpersonal conflict or failure to recall less salient episodes. Either would inhibit our ability to consider temporal relationships between substance use and conflict.

Conflict was assessed with a single item, which, although behaviorally specific, may have underestimated the number of conflicts experienced. Relatively few conflicts were reported, potentially reducing power to detect effects. Moreover, the single item did not allow us to distinguish the conflict target or types of aggression (e.g., verbal, physical). It is possible that relations between substance use and conflict differ by conflict type (Robertson et al., 2017; Laws et al., 2017). Future work should assess content and severity of interpersonal conflict, as well as the temporal precedence between conflict and substance use.

Although findings are consistent with hypothesized pharmacological effects, we cannot separate these pharmacological effects from contextual effects. That is, students use substances, particularly alcohol, in social contexts in which the odds of conflict are increased merely by the presence of others (e.g., Wells, Graham, Speechly, & Koval, 2005). Alcohol use tended to occur in contexts that involved larger numbers of people, which may have contributed to the stronger alcohol effects.

Conclusions and Future Research

These findings uniquely consider the temporal effects of alcohol, marijuana, and their simultaneous use. The strengths and limitations of this work suggest several directions for future research that utilize ecological momentary assessment (EMA) protocols. Future EMA investigations of alcohol and marijuana should signal participants throughout a drinking or marijuana use episode. Such event-based protocols would decrease the time interval between measurement of acute effects of substance use, allowing for more precise detection of associations between acute drug effects and their influence on the occurrence of interpersonal conflict or other negative consequences. In the specific case of simultaneous marijuana and alcohol use, this would allow for clear isolation of the intention to use both drugs at the same time. These event-based EMA designs are also ideal in the assessment of contextual settings of substance use, which may differ considerably by drug (e.g., Lipperman-Kreda, Paschall, Saltz, & Morrison, 2018; Phillips, Phillips, Lalonde, & Prince, 2018). Given our findings that marijuana use high is positively associated with interpersonal conflict several hours later, future simultaneous use research should also consider that modes of marijuana administration with longer lasting and/or increased concentration of THC/CBD (e.g., edibles, dabs). These may show possibility of extended acute effects (Hunault et al., 2014) that then may predict negative consequences at longer time intervals than were demonstrated in the current work.

This investigation shows the promise of intensive longitudinal designs for considering the temporal relationships between substance use and negative consequences generally, as well as for simultaneous alcohol and marijuana use and negative consequences specifically. Varied daily methodologies (web-based, longitudinal burst, ambulatory assessment), a broad assessment of negative and positive consequences of simultaneous alcohol and marijuana use, as well as diverse samples of young adults are needed to understand patterns of risk associated with simultaneous alcohol and marijuana use.

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