Are There Secondary Effects on Marijuana Use From Brief Alcohol Interventions for College Students?

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ABSTRACT. Objective: This study examined whether brief motivational interventions (BMIs) designed for reducing heavy drinking among college students have secondary effects on reducing marijuana use. **Method:** The data came from Project INTEGRATE, which combined data from 24 independent trials of BMIs and other individual-focused interventions designed to reduce heavy drinking and related problems among college students. We analyzed data from 10 samples across nine studies that used random assignment of participants into either a BMI or a control group and assessed marijuana use outcomes (N = 6,768; 41.5% men; 73.2% White; 57.7% first-year students; 19.2% current marijuana users at baseline). We derived three marijuana use groups within studies by cross-tabulating baseline and follow-up data: Nonusers, Reducers, and Stayers/Increasers. **Results:** Peto's one-step odds ratio analyses for meta-analysis revealed no significant intervention effects on marijuana use at either short-term (1–3 month) or long-term (6–12 month) follow-up. Subsequent exploratory analyses showed that those who reduced drinking were more likely to be a marijuana Reducer or Nonuser, compared with a Stayer/Increaser, at both follow-ups. **Conclusions:** The BMIs to reduce heavy drinking evaluated in this study did not reduce marijuana use. However, our exploratory results suggest that if we can develop interventions for college students that effectively reduce drinking, we may also reduce their marijuana use. Furthermore, as recreational use of marijuana becomes legal or decriminalized and marijuana becomes more readily available, it may be necessary to develop interventions specifically targeting marijuana use among college students. (*J. Stud. Alcohol Drugs, 76,* 367–377, 2015)

INCREASES IN MARIJUANA USE occur as youth transition from high school to college (Bachman et al., 1997; White et al., 2005), and marijuana is the most prevalent illicit drug used on college campuses. Recent data from the Monitoring the Future study indicate that 49% of college students report lifetime use of marijuana, 35% report past-year use, and 21% report past-month use (Johnston et al., 2013). Frequent marijuana use during the college years can result in negative health consequences, cognitive impairment, psychotic illnesses, academic problems, and accidents, all of which can have long-term effects on physical and psychological well-being (Larimer et al., 2005; Lynskey & Hall, 2000; Moore, 2005; Semple et al., 2005; Solowij, 1998; Taylor et al., 2000; White & Rabiner, 2012).

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Although most college students will outgrow marijuana use and related problems on their own before entering adulthood (Bachman et al., 2002; White et al., 2005), some will maintain or increase their problematic use over time. Furthermore, as of 2014, 17 states in the United States have decriminalized or legalized recreational marijuana use for those age 21 or older (http://norml.org/laws/). These laws may lead to even greater use among college students and, potentially, subsequent increases in related negative consequences. Thus, college presents an optimal time for intervention, given the increasing prevalence of use during these years and recent changes to marijuana-related laws. Efforts targeting individuals during this developmental window before they develop long-lasting marijuana use patterns or disorders may be particularly effective.

Brief motivational interventions

One type of intervention being used on college campuses to reduce substance use is brief motivational interventions (BMIs). BMIs are based on a harm-reduction approach and are implemented using the principles of Motivational Interviewing (MI; Miller & Rollnick, 2013) to motivate indi-

viduals to change their behavior, most typically alcohol use. BMIs commonly deliver personalized feedback on the individual's patterns and consequences of substance use as well as information regarding norms for substance use among peers, which provides a salient message to the BMI recipient and increases his or her motivation to change (Cronce & Larimer, 2012; Dimeff et al., 1999).

There is some research to support the efficacy of marijuana-focused BMIs for adolescents (e.g., D'Amico et al., 2008) and adults (e.g., Bernstein et al., 2009; Copeland et al., 2001; Marijuana Treatment Project Research Group, 2004; Stephens et al., 2000; Woolard et al., 2013), although some researchers have questioned their efficacy, especially among adults not seeking treatment (e.g., Roy-Byrne et al., 2014; Saitz et al., 2014). Only a few randomized controlled trials, however, have tested the efficacy of drug-focused BMIs with college students, and the evidence is mixed regarding the efficacy of reducing marijuana use.

In support of efficacy, McCambridge and Strang (2004) found that students in a polydrug BMI condition, compared with a control condition, reported significantly lower use rates for cigarettes and marijuana, as well as alcohol, at 3-month follow-up, but intervention effects dissipated at 12 months (McCambridge & Strang, 2005). Similarly, Lee and colleagues (2013) evaluated an in-person BMI with personalized feedback for frequent marijuana users. At 3-month follow-up, students in the intervention group, compared with the control group, reported fewer joints smoked per week. By 6-month follow-up, group differences disappeared.

In contrast, Fischer and colleagues (2013) did not find significant group differences between BMI and control groups in 3-month reductions in marijuana use frequency among university students who were high-frequency marijuana users. Nonetheless, they did find that students in the BMI group were more likely than controls to reduce their deep inhalation of marijuana. In addition, Lee and colleagues (2010) found no overall effects of a web-based personalized feedback marijuana intervention. However, students whose parents had drug problems or who were contemplating a change in their marijuana use at baseline reported greater reductions in marijuana use frequency in the intervention group relative to the control group. Another recent study by Elliott and colleagues (2014) evaluated a web-based BMI for marijuana use with volunteer college students. At the 1-month follow-up, there were no significant differences in marijuana use frequency or related problems between intervention and assessment-only control groups.

Effects of alcohol-focused brief interventions on marijuana use

In contrast to the limited body of research on marijuana-focused BMIs among college students, there is well over two decades of literature on BMIs targeting heavy drinking among college students (Cronce & Larimer, 2012). Although alcohol-focused BMIs are geared specifically to drinking, it is possible that these BMIs will have effects on marijuana use because marijuana use and heavy drinking share many of the same precursors and correlates. Thus, interventions that modify some of the risk factors for heavy drinking may have a secondary effect on marijuana use by challenging their common etiological pathways (Larimer et al., 2005). Furthermore, because marijuana is often used simultaneously with alcohol (Barrett et al., 2006; Magill et al., 2009), a reduction in drinking frequency may reduce occasions for marijuana use, resulting in reductions in use. In fact, in a joint trajectory analysis, Jackson and colleagues (2008) found that young adults (ages 18–26 years) who reduced their heavy episodic drinking simultaneously reduced their marijuana use (see also Tucker et al., 2005).

To date, there is tentative evidence that alcohol-focused interventions have secondary effects on marijuana use. In a study of heavy drinking youth (ages 18–24 years) admitted to the emergency department, Magill and colleagues (2009) found that marijuana users in two alcohol-focused BMIs (i.e., a personalized feedback-only intervention and a motivational interview with feedback) reduced their marijuana use from baseline to the 6-month follow-up. In an earlier analysis, the researchers demonstrated that both groups also reduced their alcohol use (Monti et al., 2007). Similarly, Kazemi and colleagues (2012) found that an alcohol intervention for first-year college students led to decreased use of marijuana as well as alcohol 6 months later. However, it is difficult to attribute the reductions in marijuana use to the interventions because neither of these studies included a control group.

Grossbard et al. (2010) is the only randomized controlled trial, to our knowledge, that tested whether an alcohol intervention for college students had contagion effects on marijuana, cigarettes, and other illicit drug use. In a sample of college students who had participated in athletics in high school, they found that a combined individual BMI and parent-based intervention for alcohol use had a significant effect on first-year students' marijuana use compared with an alcohol-focused BMI without parent-based intervention and an assessment-only control. Students in the latter two groups increased their marijuana use at 10-month follow-up, whereas those in the combined intervention did not. However, given the relatively selective and homogeneous sample, more research is needed with broader samples of college students to determine whether brief alcohol interventions produce secondary benefits on marijuana use outcomes.

Present study

The purpose of this study was to build on previous literature and examine whether alcohol-focused BMIs have secondary benefits in reducing marijuana use. This study takes

Table 1. Description of studies included in the current study

Study	Reference	Type of sample	Randomized group *n*	BMI type[c]	BMI length (no. of sessions)	BMI provider[d]	Follow-up schedule, in months	% Past-month marijuana use (baseline)
2	White et al. (2008)	Mandated	111	PF	N.A.	N.A.	2	14.8
			119	Control	N.A.	N.A.		
7.1[a]	Fromme & Corbin (2004)	Mandated	100	GMI	two 2-hr. sessions	G, U	1	48.3
			24	Control	N.A.	N.A.		
7.2	Fromme & Corbin (2004)	Volunteer	317	GMI	two 2-hr. sessions	G, U	1, 6	34.8
			135	Control	N.A.	N.A.		
8a[b]	Larimer et al. (2007)	Volunteer	736	PF	N.A.	N.A.	12	16.1
			750	Control	N.A.	N.A.		
8b	Larimer et al. (2007)	Volunteer	1,094	PF	N.A.	N.A.	12	11.4
			1,061	Control	N.A.	N.A.		
8c	Larimer et al. (2007)	Volunteer	303	PF	N.A.	N.A.	12	38.0
			297	Control	N.A.	N.A.		
9	Lee et al. (2009)	Heavy drinkers	97	GMI	two 90-min. sessions	U	3, 6	27.1
			101	MI + PF	one 1-hr. sessions	G, U		
			100	PF	N.A.	N.A.		
			101	Control	N.A.	N.A.		
10	Baer et al. (2001)	Heavy drinkers	174	MI + PF	one 1-hr. session	C, G	12	15.0
			174	Control	N.A.	N.A.		
16	LaBrie et al. (2009)	Volunteer women	161	GMI	one 2-hr. session	C, B	3, 6	12.7
			126	Control	N.A.	N.A.		
20	Larimer et al. (2001)	Fraternity	318	MI + PF	one 1-hr. session	C, G, U	12	20.7
			369	Control	N.A.	N.A.		

Notes: BMI = brief motivational intervention; no. = number; hr. = hour; min. = minute; PF = personalized feedback; GMI = motivational interviews delivered in small-group formats; MI = motivational interviewing. N.A. = not applicable. [a]Study 7 was divided into two subsamples to indicate two distinct samples, mandated (7.1) and volunteer (7.2) students. These samples differed in their marijuana use patterns and hence are treated as two distinctive samples in the analysis; [b]Studies 8a, 8b, and 8c were conducted as part of a multisite intervention study (Larimer et al., 2007) and thus shared many design aspects in common. However, they were conducted at three different universities at three different times using three different sets of drinking norms. Furthermore, students were randomized separately at each university. Thus, Studies 8a, 8b, and 8c have been treated as three different studies in Project INTEGRATE (see Mun et al., 2015, for detail); [c]all MI + PF and GMI interventions were delivered in person. All PF interventions used computer generated feedback delivered to participants in-person (Study 2), via mail (Studies 8a, 8b, 8c), or via the web (Study 9); [d]BMI Provider: C = certified or Ph.D.-level clinician; G = graduate student; B = postbaccalaureate research assistant; U = undergraduate student.

advantage of a large-scale, multisite data set from Project INTEGRATE (see Mun et al., 2015, for detail), an integrative data analysis study that pooled individual participant-level data from 24 BMI studies targeting college drinking. This large, heterogeneous sample is more advantageous for examining changes in marijuana use relative to individual studies because of the relatively low frequency of marijuana use on college campuses. The hypothesis that interventions for drinking may affect marijuana use is based, in part, on an assumption that reductions in drinking are related to reductions in marijuana use. Nevertheless, brief interventions do not necessarily work well for all individuals (Mun et al., 2009). Furthermore, students may reduce their drinking for other reasons besides an intervention, such as maturation (Bachman et al., 2002) or experiencing a serious alcohol-related incident (Barnett et al., 2006; Morgan et al., 2008). Therefore, we conducted an exploratory analysis to determine if reductions in drinking were related to reductions in marijuana use irrespective of receiving an intervention.

Method

Participants

Data came from a large intervention data set included in Project INTEGRATE (see Mun et al., 2015). We used data from nine randomized controlled trials (a total of 10 different samples; see Table 1) that evaluated alcohol-focused BMIs and assessed marijuana use. BMIs included in this analysis were in-person motivational interviews with personalized feedback (MI + PF); stand-alone personalized feedback (PF) delivered either by hand, by mail, or over the Internet; and motivational interviews delivered in person in small group formats (GMI) (for greater detail on these interventions, see Ray et al., 2014). MI sessions were facilitated by professionals, graduate students, undergraduate students, or postbaccalaureate research assistants (see Table 1 for details).

The baseline sample consisted of 6,768 students (41.5% men) who were randomly assigned to either a BMI (*n* =

3,612) or control (n = 3,156) condition. Most of the students were first-year students (57.7%), with 20.5% second year, 15.6% third year, and 6.3% fourth year and beyond. The majority of the sample was White (73.2%), 15.3% were Asian, 4.7% Hispanic, 1.6% Black, and 5.2% another or mixed race/ethnicity. Of the total sample, 75 participants (~1% of the total sample) had missing data on marijuana use at baseline and were subsequently excluded from the analyses.

Students completed follow-up assessments either in person, by mail, or over the Internet at various time points. Given that there was very little overlap in follow-ups across studies beyond 12 months after intervention, we limited analyses to outcome data from 1 month up to 12 months after baseline (Tables 1 and 2). Analyses were conducted separately for short-term (1–3 months after baseline) and long-term (6–12 months after baseline) follow-up data. The short-term analyses (82.5% followed up) include four studies (five samples), and the long-term analyses (67.2% followed up) include eight studies. Data from Studies 7.2, 9, and 16 were included in both short- and long-term analyses. Overall, 70.6% (n = 4,776) of the sample completed at least one follow-up.

Measures

Intervention condition. Students were randomly assigned to an intervention group (MI + PF, PF, or GMI; coded 1) or control group (coded 0). Each study had one BMI and one control condition except Study 9, which had all three BMI groups (combined for the current study). Seven of the nine studies included an assessment-only control group. Study 20 provided basic educational information on alcohol to the control group, and Study 16 provided the control group with handouts on alcohol use and consequences.

Marijuana use. In the original studies, marijuana use frequency was assessed slightly differently, ranging from past-month to past-year use with variations in response options. In all cases, students self-reported their marijuana use at baseline and follow-up either on paper-and-pencil questionnaires or computerized surveys (see Table 2 for details). We harmonized the marijuana variable across studies and time frames into an ordinal variable that indicated frequency of use in the last month: 0 = *no use in the past month,* 1 = *once a month,* 2 = *2–3 times per month,* 3 = *1–2 times per week,* 4 = *3–4 times per week,* and 5 = *5 or more times per week.* There were considerable differences in past-month prevalence of marijuana use at baseline across studies, ranging from just over one tenth of the students in Study 8b to almost one half in Study 7.1 (Table 1).

Alcohol use. Alcohol use was measured using the Daily Drinking Questionnaire (DDQ; Collins et al., 1985). The DDQ asks students to indicate the number of drinks they consumed each day during a typical week (in either the last month or last 3 months, depending on the study). The number of drinks was summed across the 7 days to create a measure of the number of drinks per week at baseline (M = 7.6; SD = 9.8; 28.7% zero drinks), short-term follow-up (M = 9.5; SD = 10.6; 17.2% zero drinks), and long-term follow-up (M = 7.0; SD = 9.8; 26.9% zero drinks). Note that Study 16 did not assess the DDQ and did not have a consistent measure of the number of drinks per week across assessment periods. It was thus excluded from exploratory analyses examining changes in alcohol use.

Demographic covariates. Several demographic covariates were included: gender (1 for men, 0 for women), race (1 for White, 0 for non-White), and year in school (1 for first-year, 0 for all other years). Year in school is a proxy for age because age was not assessed in some of the original studies.

Analysis

BMIs were compared against their own controls within studies when estimating individual effects and overall effects across studies. Seven of 10 samples had just one follow-up assessment, and current marijuana use prevalence rates were quite low (Table 1), with extended tails (skew) across studies. Furthermore, no use in the past month is qualitatively different from some use and can be a clinically meaningful behavior, which could be lost if marijuana change is treated as an increment on an ordered ordinal scale. Thus, we adopted a categorical outcome analysis approach and accordingly used a meta-analysis method for event (i.e., binary) data (i.e., Peto's one-step odds ratio analysis; Yusuf et al., 1985). Peto's method is commonly used in medical meta-analysis research. We used the "metafor" package (Viechtbauer, 2010) developed for the R environment (R Development Core Team, 2011) to implement Peto's method.

To examine marijuana use patterns over time, we first cross-tabulated baseline and follow-up data for each study separately for the short-term and long-term follow-ups. Based on the cross-tabulated data, we defined three groups of participants. The first group included students who did not use marijuana in the past month at both baseline and follow-up (continued current "Nonusers"). As stated above, we felt that it was necessary to examine this group separately because students in this group could not have reduced their use (i.e., improve), but their continued nonuse could be attributable to a positive intervention effect. The remaining students were grouped into those who reduced their frequency of marijuana use from baseline to follow-up ("Reducers") and those who remained the same or increased their use ("Stayers/Increasers"). Table 3 shows the percentages of these groups across studies for the short- and long-term follow-ups. We then examined whether BMIs increased the odds of being a Reducer or Nonuser relative to being a Stayer/Increaser.

With regard to those whose marijuana use follow-up data were not available, attrition analyses indicated significant

Table 2. Variation in the measurement of marijuana use across studies and harmonization of marijuana use

Study	Original question	Original response scale	Harmonized response scale: Past-month use
2	How often have you used marijuana or hashish in the last month?[b]	0 = Never and not in the last month 1 = About once per month 2 = 2 or 3 times per month 3 = Once or twice per week 4 = 3 or 4 times per week 5 = Every day or nearly every day	0 = 0. No use in the past month 1 = 1. Once a month 2 = 2. 2–3 times per month 3 = 3. 1–2 times per week 4 = 4. 3–4 times per week 5 = 5. 5 or more times per week
7	Number of times used marijuana in past month[b]	Open ended, ranging from 0 to more than 31 times	0 = 0. No use in the past month 1 = 1. Once a month 2–3 = 2. 2–3 times per month 4–11 = 3. 1–2 times per week 12–19 = 4. 3–4 times per week 20+ = 5. 5 or more times per week
8a, 8b, 8c	How often have you used marijuana in the past year?[d]	0 = Never 1 = 1–2 times per year 2 = 6 times per year 3 = 1 time per month 4 = 2 times per month 5 = 1 time per week 6 = 3 times per week 7 = 5 times per week 8 = Every day	0–2 = 0. No use in the past month 3 = 1. Once a month 4 = 2. 2–3 times per month 5 = 3. 1–2 times per week 6 = 4. 3–4 times per week 7 & 8 = 5. 5 or more times per week
9	Please describe your frequency of marijuana use in the past year[d]	0 = Once in last year (or not in last year) 1 = A few times in last year 2 = About every other month 3 = About once per month 4 = A few times per week[a] 5 = About once a week 6 = About every day/daily 7 = Multiple times per day	0–2 = 0. No use in the past month 3 = 1. Once a month 4 & 5 = 3. 1–2 times per week 6 & 7 = 5. 5 or more times per week
10	During the past 6 months, how often have you used marijuana or hashish?[c]	0 = I have not used 1 = Less than once per month 2 = About once per month 3 = 2 or 3 times per month 4 = Once or twice a week 5 = 3 or 4 times per week 6 = Every day or nearly every day	0 & 1 = 0. No use in the past month 2 = 1. Once a month 3 = 2. 2–3 times per month 4 = 3. 1–2 times per week 5 = 4. 3–4 times per week 6 = 5. 5 or more times per week
16	Within the last year, about how often have you used marijuana?[d]	0 = Never 1 = Less than once per month 2 = About once per month 3 = 2–3 times per month 4 = Once a week 5 = Twice a week 6 = 3 times per week 7 = 4 times per week 8 = 5–6 times per week 9 = Every day	0 & 1 = 0. No use in the past month 2 = 1. Once a month 3 = 2. 2–3 times per month 4 & 5 = 3. 1–2 times per week 6 & 7 = 4. 3–4 times per week 8 & 9 = 5. 5 or more times per week
20	During the past 6 months, how often have you used marijuana or hashish?[e]	0 = I have not used 1 = Less than once per month 2 = About once per month 3 = 2 or 3 times per month 4 = Once or twice per week 5 = 3 or 4 times per week 6 = Every day or nearly every day	0 & 1 = 0. No use in the past month 2 = 1. Once a month 3 = 2. 2–3 times per month 4 = 3. 1–2 times per week 5 = 4. 3–4 times per week 6 = 5. 5 or more times per week

[a]There was a typo in the questionnaire in Study 9. The response option "a few times per week" was supposed to be "a few times per month." It is possible that some participants might have misread the response option as "a few times per month" given its position among the response options. Because the response for a few times per week preceded the response for once a week, we decided to combine these answers and recode them as "1–2 times per week"; [b]computerized self-report in-person at baseline and follow-up; [c]paper-and-pencil self-report in-person at baseline and follow-up; [d]web-based survey at baseline and follow-up; [e]paper-and-pencil self-report in-person at baseline and follow-up, although respondents who had moved out of the fraternity/sorority house completed paper-and-pencil self-report questionnaires and mailed them in at follow-up.

TABLE 3. Percentage of Reducers, Nonusers, and Stayers/Increasers by intervention condition and study separately for short-term and long-term follow-ups

Study	Group	Reducers %	Nonusers %	Stayers/ Increasers %
Short-term follow-up (1–3 months)				
2	Intervention (n = 95)	11.6	79.0	9.5[a]
	Control (n = 104)	1.9	83.7	14.4
7.1	Intervention (n = 78)	21.8	48.7	29.5
	Control (n = 24)	8.3	54.2	37.5
7.2	Intervention (n = 217)	15.7	59.9	24.4
	Control (n = 110)	12.7	60.9	26.4
9	Intervention (n = 255)	7.8	67.5	24.7
	Control (n = 83)	10.8	60.2	28.9[a]
16	Intervention (n = 146)	5.5	85.6	8.9
	Control (n = 118)	6.8	87.3	5.9
Long-term follow-up (6–12 months)				
7.2	Intervention (n = 147)	17.7	58.5	23.8
	Control (n = 72)	13.9	63.9	22.2
8a	Intervention (n = 489)	9.2	81.4	9.4
	Control (n = 491)	6.7	81.3	12.0
8b	Intervention (n = 748)	6.0	86.0	8.0
	Control (n = 761)	5.9	87.8	6.3
8c	Intervention (n = 97)	12.4	56.7	30.9
	Control (n = 132)	18.9	55.3	25.8
9	Intervention (n =239)	7.5	66.1	26.4
	Control (n = 85)	14.1	55.3	30.6
10	Intervention (n = 155)	10.3	71.6	18.1
	Control (n = 164)	5.5	79.3	15.2
16	Intervention (n = 135)	8.2	84.4	7.4
	Control (n = 109)	4.6	89.0	6.4
20	Intervention (n = 226)	8.9	77.4	13.7
	Control (n = 257)	10.5	75.1	14.4

[a]Percentages do not add to 100% because of rounding.

differences for 4 of the 10 samples (i.e., Studies 8a, 8b, 16, and 20). In these studies, those lost at follow-up were more likely to have used marijuana in the past month at baseline than those who completed at least one follow-up. The magnitude of the associations was small in general, but this raises the possibility that outcome analyses based on complete cases may be biased. Thus, we imputed data for marijuana use at both the short- and long-term follow-ups, separately for each study, and repeated Peto's method. We included gender, race, year in school, intervention condition, and baseline alcohol and marijuana use in the imputation model. Because we had a mix of categorical and continuous variables in the imputation model and because of the nonmonotonic pattern of missing data, we implemented a fully conditional specification method (Enders, 2010) using the SAS 9.3 (SAS Institute Inc., Cary, NC) PROC MI procedure. This method generated a single imputed data set. Results from the meta-analyses with the imputed data and complete cases were quite similar, and none of the null hypothesis significance tests changed for each individual study as well as for the overall effect. Thus, we concluded that the results based on the complete-case analysis were not meaningfully affected by attrition at follow-up and report results from the complete-case analysis (the results from the imputed data are available on request).

For the exploratory analysis on the association between changes in alcohol and marijuana use, we used multinomial logistic regression within the complex survey analysis framework in Mplus (Version 7.2; Muthén & Muthén, 1998–2014). These analyses were conducted separately for the short- and long-term outcome data. The outcome variable was marijuana use change group membership, as described above, with the Stayers/Increasers as the referent group. Covariates were intervention condition (intervention vs. control), men (vs. women), first-year student (vs. other years), and White (vs. non-White). In addition, a set of dummy variables for study number (with samples 7.1 and 7.2 treated as separate studies) was added to each analysis to account for between-study differences in the proportion of marijuana use groups. For these dummy variables, Study 9 was set as the referent group because Study 9 had both short- and long-term follow-up data, had a modest (neither too small nor too large) sample size, and its sample was not extreme in terms of marijuana use.

Change in alcohol was defined as the number of drinks per week at follow-up minus the number of drinks per

week at baseline. Because of high kurtosis of the change scores, those cases with scores lower than the first percentile or higher than the 99th percentile were removed from this analysis. Those removed cases had change scores that well exceeded three *SD*s from the mean (with these cases removed, the weighted mean for short-term change = -1.26, *SD* = 5.79, range: -23 to 19; the weighted mean for long-term change = -0.40, *SD* = 6.22, range: -22 to 24). Because of highly discrepant sample sizes across studies, responses were weighted by applying an inverse of the square root of each study sample size. For other descriptive statistics, we used SAS 9.3.

Results

Intervention effects on changes in marijuana use

Table 3 shows the percentage of Reducers, Nonusers, and Stayers/Increasers for the intervention and control groups within each study at the short- and long-term follow-ups. Across studies, a large majority of the sample was Nonusers, who did not use marijuana within the past month at both baseline and either the short-term (69.9%) or long-term (78.8%) follow-up. There were proportionally more Reducers than Stayers/Increasers at both the short-term (19.9% vs. 10.2%) and long-term (12.9% vs. 8.3%) follow-ups.

For both the short- and long-term outcomes, we derived odd ratios (ORs) and 95% confidence intervals (CIs) from individual 2 × 2 tables for each study as well as the combined, overall OR (Table 4). There was no statistically significant heterogeneity in ORs across studies: short-term Nonusers vs. Stayers/Increasers, *Q* test of heterogeneity $\chi^2(4) = 1.90$, $p = .75$; short-term Reducers vs. Stayers/Increasers, $\chi^2(4) = 8.97$, $p = .06$; long-term Nonusers vs. Stayers/Increasers, $\chi^2(7) = 5.83$, $p = .56$; long-term Reducers vs. Stayers/Increasers, $\chi^2(7) = 8.64$, $p = .28$.

Neither the short- nor long-term combined OR was statistically significant. In other words, there were no secondary intervention effects of alcohol BMIs on marijuana use over time. The combined overall results were consistent with findings from the individual studies. One exception was Study 2, in which the intervention group, compared with the control group, was more likely to reduce marijuana use than to stay the same or increase over the short term.

Exploratory analysis regressing changes in marijuana use on changes in alcohol use

We conducted exploratory multinomial logistic regression analyses (full results are available on request) for the short-term changes (Studies 2, 7.1, 7.2, and 9; $n = 926$) and long-term changes (Studies 7.2, 8a, 8b, 8c, 9, 10, and 20; $n = 3{,}657$) in marijuana use in relation to alcohol use. Starting with Reducers versus Stayers/Increasers, after we adjusted for effects of demographic covariates and intervention condition, the odds of being a marijuana Reducer, compared with a Stayer/Increaser, statistically significantly ($p < .05$) increased as alcohol use decreased; logistic regression coefficient estimate = 0.03 (*SE* = 0.01) for the short-term and 0.05 (*SE* = 0.02) for the long-term outcome analysis. In the comparison between Nonusers and Stayers/Increasers, for each one-drink reduction, the odds of remaining a nonuser of marijuana statistically significantly ($p < .05$) increased; logistic regression coefficient estimate = 0.01 (*SE* = 0.00) for the short-term and 0.02 (*SE* = 0.01) for the long-term outcome analysis.

Table 4. Odds ratios (OR) and 95% confidence intervals (CI) comparing the intervention to the control group for Reducers vs. Stayers/Increasers and Nonusers vs. Stayers/Increasers at short-term and long-term follow-up

Study	Reducers vs. Stayers/Increasers OR [95% CI]	Nonusers vs. Stayers/Increasers OR [95% CI]
Short-term follow-up (1–3 months; $n = 1{,}230$)		
Study 2	6.33 [1.67, 24.09]	1.42 [0.60, 3.36]
Study 7.1	2.77 [0.71, 10.88]	1.14 [0.42, 3.09]
Study 7.2	1.32 [0.62, 2.81]	1.06 [0.62, 1.82]
Study 9	0.85 [0.33, 2.13]	1.32 [0.74, 2.36]
Study 16	0.55 [0.15, 2.04]	0.66 [0.26, 1.66]
Overall	**1.39 [0.87, 2.22]**	**1.12 [0.82, 1.54]**
Long-term follow-up (6–12 months; $n = 4{,}307$)		
Study 7.2	1.18 [0.47, 2.99]	0.86 [0.43, 1.69]
Study 8a	1.74 [0.97, 3.12]	1.28 [0.85, 1.92]
Study 8b	0.80 [0.46, 1.40]	0.77 [0.52, 1.14]
Study 8c	0.56 [0.25, 1.26]	0.85 [0.47, 1.56]
Study 9	0.61 [0.25, 1.48]	1.40 [0.79, 2.49]
Study 10	1.57 [0.60, 4.06]	0.76 [0.42, 1.38]
Study 16	1.52 [0.37, 6.13]	0.82 [0.61, 2.22]
Study 20	0.89 [0.42, 1.86]	1.08 [0.64, 1.82]
Overall	**1.00 [0.77, 1.32]**	**0.98 [0.81, 1.18]**

Discussion

This study analyzed a large pooled data set from nine independent college intervention studies (10 samples) to examine whether alcohol-focused BMIs designed to reduce heavy drinking also reduced marijuana use. Overall, we did not find evidence of significant secondary intervention effects on reductions in marijuana use. The lack of secondary effects on marijuana use may not be surprising. Previous analyses from this project did not find a significant overall intervention effect on alcohol use and related problems (Huh et al., 2015). More specifically, Huh and colleagues analyzed individual participant-level data from 17 randomized BMI trials that were included in Project INTEGRATE and did not find significant overall intervention effects on drinks per week, peak number of drinks, or alcohol problems. The only positive finding was that in-person personalized feedback interventions (MI + PF), compared with controls, had a small effect on reducing alcohol problems in post hoc comparisons

of the three BMI conditions (MI + PF, PF, and GMI). Given that these interventions did not lead to significant reductions in their primary target outcome (i.e., heavy drinking), it is perhaps not remarkable that there were no significant effects for marijuana. In other words, had there been a positive effect on reducing drinking, we might have seen a positive effect on reducing marijuana use.

At the individual study level, we did find a significant intervention effect on marijuana use at the 2-month follow-up for Study 2. Interestingly, although the BMI for Study 2 focused primarily on alcohol use, personalized feedback was also provided on marijuana and other drug use (e.g., a student's frequency of marijuana use, his or her perceptions of the prevalence of marijuana use by college students, and the actual prevalence for same-sex college students nationally), as well as drug-related consequences (i.e., a list of negative consequences experienced in the last year because of drug use; see White et al., 2008). No other study analyzed in the present study included personalized feedback on marijuana use, although Study 7 included feedback on drug use in general. Thus, marijuana feedback content may be the reason for an intervention effect on marijuana use in Study 2. However, even with more in-depth marijuana feedback, Lee et al. (2010) did not find a significant overall effect of a web-based intervention, suggesting that more research is needed on PF interventions for marijuana.

We had no a priori hypothesis regarding whether the alcohol-focused BMIs would affect continued current nonuse of marijuana but felt that maintaining continued current nonuse was a reasonable intervention goal to examine. We found no evidence that the interventions affected continued nonuse. It should be kept in mind that alcohol-focused BMIs typically use a harm-reduction approach (e.g., Dimeff et al., 1999) and do not emphasize abstinence, which may explain why there was no intervention effect on marijuana nonuse.

There are many reasons why college students may reduce their heavy drinking over time, such as maturing out (e.g., Bachman et al., 2002), getting in trouble for breaking university regulations regarding use (e.g., Morgan et al., 2008), or experiencing a serious alcohol-related incident (Barnett et al., 2006). Therefore, it is important to look at the association between changes in alcohol and marijuana use beyond intervention effects. Our sample was not ideal to address this question because we did not have commensurate measures of alcohol and marijuana use at all points in time or a balanced spacing of follow-ups. Nonetheless, in exploratory analysis, we found that reductions in alcohol use were related to reductions in marijuana use within this college sample. Although these changes cannot be attributed to the interventions, they do indicate that whatever factors influence students to reduce their drinking (e.g., policy, goal, or perceived norm changes) may also influence them to reduce their marijuana use. This finding is consistent with trajectory studies of young adults (Jackson et al., 2008; Tucker et al., 2005). Furthermore, these results suggest that the majority of students who reduce their drinking are not turning to marijuana as a replacement. Magill and colleagues (2009) found that those who reduced their drinking did not replace alcohol use with marijuana use. Taken together, these studies suggest that marijuana is "a complement rather than a substitute for alcohol" (Pape et al., 2009, p. 69). More research is needed to understand which, as well as how, individual and contextual factors influence youth to reduce their drinking and their marijuana use.

The findings from this study should be interpreted with consideration of the limitations. The nine studies analyzed in the present study were not a random sample of alcohol BMI trials in the literature. In addition, all trials included in the current study were conducted before 2009. Therefore, the data set may not include newer, potentially more innovative or effective alcohol interventions. Nonetheless, the large-scale pooled data set from Project INTEGRATE features a fairly representative sample of BMIs conducted during the past three decades (see Mun et al., 2015, for greater detail). Even so, the findings from this study should be interpreted with some caution as to their generalizability. Another important limitation is that the number and duration of follow-ups during the 12 months after intervention were limited. Consequently, not all studies had both short- and long-term follow-up data. Thus, the findings from the short- and long-term analyses may reflect study-level differences that were unaccounted for, in addition to differences resulting from the duration of the follow-up. Furthermore, we cannot be confident that students maintained reductions, increases, or nonuse as identified in this study beyond 12 months.

Other limitations relate to our measure of marijuana use. The marijuana use measures were based only on self-report, although O'Malley et al. (1983) found that self-reports of marijuana use are reliable. Furthermore, it was necessary to harmonize measures and establish measurement equivalence across studies and time, which is true for any integrative data analysis study (Hussong et al., 2013). Whereas alcohol use was assessed consistently across studies by using the DDQ, the marijuana use measure differed across studies. Specifically, one study used a continuous measure of the number of days marijuana was used in the past month, whereas the others used ordinal scales of the frequency of marijuana use in the last month, 6 months, or year. We harmonized these various marijuana use measures into a consistent ordinal scale that captured past-month use. However, our harmonized response scale may be somewhat imprecise for studies that originally asked about the past year, especially for individuals at the lower end of this new scale (i.e., not in the past month).

With the exceptions of Study 7 and Study 8c, most of the studies had marijuana prevalence rates of approximately 20% during the past month at baseline. This relatively low prevalence of marijuana use in the past month, although not

low in an absolute sense, can make it difficult to analyze data from individual studies with small or modest sample sizes. Fortunately, by pooling data from multiple sources, we were able to use all available data to examine the secondary intervention effect on marijuana use while achieving greater precision, power, and generalizability of the findings than is possible in single studies. Nevertheless, this study is still limited because of the coarse nature of the marijuana use measure. A more fine-grained measure of use would have made it possible to examine the extent of the reduction in marijuana use in response to a BMI over time. Despite these limitations, this study makes an important contribution to the literature. By combining data from nine intervention trials and using an innovative analytical approach, we examined intervention effects within and across studies.

It is clear that greater effort is needed to reduce heavy drinking and marijuana use on college campuses. After demonstrating that several common risk and protective factors partially accounted for the comorbidity between patterns of heavy drinking and marijuana use, Jackson and colleagues (2008) argued that it might be better to design interventions to focus on polysubstance use rather than on the use of a single substance. At the same time, there may be barriers to designing integrated interventions for polysubstance use given the stigma associated with drug use. Larimer et al. (2005) pointed out that college administrators might be more reluctant to devote resources to reducing drug use, compared with alcohol use, because doing so may be an acknowledgment that a drug problem exists at their school. Overall, our results suggest that if we can design interventions that reduce heavy drinking among college students, marijuana use may also decline. Therefore, given the limited resources on college campuses for addressing substance use among students, focusing on reducing heavy drinking could be an acceptable alternative to directly addressing student marijuana use (Larimer et al., 2005) and could provide essentially two interventions for the price of one.

Nevertheless, as recreational use of marijuana becomes legal or decriminalized and marijuana becomes more readily available, it may be necessary to develop interventions specifically targeted for marijuana use. Whereas several reviews and meta-analyses support the use of BMIs for substance use among youth and adults (e.g., Burke et al., 2003; Dunn et al., 2001; Noonan & Moyers, 1997), most of the studies included in these analyses evaluated interventions for alcohol rather than marijuana or other illicit drugs. Furthermore, many of the interventions for illicit drug use have not been focused on a specific drug, and their generic approach to any illicit drug use may not be adequate to deal with the heterogeneity across classes of drugs and types of drug users. Saitz and colleagues (2014) suggested that interventions for illicit drug use might require longer, more intense strategies than a simple BMI, especially with drug users not seeking treatment. Thus, with respect to the efficacy of BMIs for marijuana and other illicit drug use, the jury is still out for college student populations as well as for general populations. More carefully planned clinical trials targeted specifically at marijuana use are needed.

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References

Bachman, J. G., O'Malley, P. M., Schulenberg, J. E., Johnston, L. D., Bryant, A. L., & Merline, A. C. (2002). *The decline of substance use in young adulthood: Changes in social activities, roles, and beliefs.* Mahwah, NJ: Erlbaum.

Bachman, J. G., Wadsworth, K. N., O'Malley, P. M., Johnston, L. D., & Schulenberg, J. E. (1997). *Smoking, drinking and drug use in young adulthood: The impacts of new freedoms and new responsibilities.* Mahwah, NJ: Erlbaum.

Baer, J. S., Kivlahan, D. R., Blume, A. W., McKnight, P., & Marlatt, G. A. (2001). Brief intervention for heavy-drinking college students: 4-year follow-up and natural history. *American Journal of Public Health, 91,* 1310–1316.

Barnett, N. P., Goldstein, A. L., Murphy, J. G., Colby, S. M., & Monti, P. M. (2006). "I'll never drink like that again": Characteristics of alcohol-related incidents and predictors of motivation to change in college students. *Journal of Studies on Alcohol, 67,* 754–763.

Barrett, S. P., Darredeau, C., & Pihl, R. O. (2006). Patterns of simultaneous polysubstance use in drug using university students. *Human Psychopharmacology: Clinical and Experimental, 21,* 255–263.

Bernstein, E., Edwards, E., Dorfman, D., Heeren, T., Bliss, C., & Bernstein, J. (2009). Screening and brief intervention to reduce marijuana use among youth and young adults in a pediatric emergency department. *Academic Emergency Medicine, 16,* 1174–1185.

Burke, B. L., Arkowitz, H., & Menchola, M. (2003). The efficacy of motivational interviewing: A meta-analysis of controlled clinical trials. *Journal of Consulting and Clinical Psychology, 71,* 843–861.

Collins, R. L., Parks, G. A., & Marlatt, G. A. (1985). Social determinants of alcohol consumption: The effects of social interaction and model status on the self-administration of alcohol. *Journal of Consulting and Clinical Psychology, 53,* 189–200.

Copeland, J., Swift, W., Roffman, R., & Stephens, R. (2001). A randomized controlled trial of brief cognitive-behavioral interventions for cannabis use disorder. *Journal of Substance Abuse Treatment, 21,* 55–64, discussion 65–66.

Cronce, J., & Larimer, M. E. (2012). Brief individual-focused alcohol interventions for college students. In H. R. White & D. L. Rabiner (Eds.), *College students drinking and drug use* (pp. 161–183). New York, NY: Guilford.

D'Amico, E. J., Miles, J. N. V., Stern, S. A., & Meredith, L. S. (2008). Brief motivational interviewing for teens at risk of substance use consequences: A randomized pilot study in a primary care clinic. *Journal of Substance Abuse Treatment, 35,* 53–61.

Dimeff, L. A., Baer, J. S., Kivlahan, D. R., & Marlatt, G. A. (1999). *Brief alcohol screening and intervention for college students: A harm reduction approach.* New York, NY: Guilford.

Dunn, C., Deroo, L., & Rivara, F. P. (2001). The use of brief interventions adapted from motivational interviewing across behavioral domains: A systematic review. *Addiction, 96,* 1725–1742.

Elliott, J. C., Carey, K. B., & Vanable, P. A. (2014). A preliminary evaluation of a web-based intervention for college marijuana use. *Psychology of Addictive Behaviors, 28,* 288–293.

Enders, C. K. (2010). *Applied missing data analysis.* New York, NY: Guilford.

Fischer, B., Dawe, M., McGuire, F., Shuper, P. A., Capler, R., Bilsker, D., . . . Rehm, J. (2013). Feasibility and impact of brief interventions for frequent cannabis users in Canada. *Journal of Substance Abuse Treatment, 44,* 132–138.

Fromme, K., & Corbin, W. (2004). Prevention of heavy drinking and associated negative consequences among mandated and voluntary college students. *Journal of Consulting and Clinical Psychology, 72,* 1038–1049.

Grossbard, J. R., Mastroleo, N. R., Kilmer, J. R., Lee, C. M., Turrisi, R., Larimer, M. E., & Ray, A. (2010). Substance use patterns among first-year college students: Secondary effects of a combined alcohol intervention. *Journal of Substance Abuse Treatment, 39,* 384–390.

Huh, D., Mun, E. Y., Larimer, M. E., White, H. R., Ray, A. E., Rhew, I. C., Kim S. Y., Jiao, Y., & Atkins, D. C. (2015). Brief motivational interventions for college student drinking may not be as powerful as we think: An individual participant-level data meta-analysis. *Alcoholism: Clinical and Experimental Research, 39,* 919–931.

Hussong, A. M., Curran, P. J., & Bauer, D. J. (2013). Integrative data analysis in clinical psychology research. *Annual Review of Clinical Psychology, 9,* 61–89.

Jackson, K. M., Sher, K. J., & Schulenberg, J. E. (2008). Conjoint developmental trajectories of young adult substance use. *Alcoholism: Clinical and Experimental Research, 32,* 723–737.

Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E. (2013). *Monitoring the Future: National survey results on drug use, 1975-2012, Vol. 1* (NIH Publication No. 04-5507). Bethesda, MD: Department Health and Human Services.

Kazemi, D. M., Dmochowski, J., Sun, L., Grady, K., Nies, M. A., & Walford, S. (2012). Brief motivational interviewing to reduce alcohol consumption among freshmen: Secondary effects on polydrug use. *Journal of Substance Use, 17,* 442–455.

LaBrie, J. W., Huchting, K. K., Lac, A., Tawalbeh, S., Thompson, A. D., & Larimer, M. E. (2009). Preventing risky drinking in first-year college women: Further validation of a female-specific motivational-enhancement group intervention. *Journal of Studies on Alcohol and Drugs, Supplement 16,* 77–85.

Larimer, M. E., Kilmer, J. R., & Lee, C. M. (2005). College student drug prevention: A review of individually-oriented prevention strategies. *Journal of Drug Issues, 35,* 431–456.

Larimer, M. E., Lee, C. M., Kilmer, J. R., Fabiano, P. M., Stark, C. B., Geisner, I. M., . . . Neighbors, C. (2007). Personalized mailed feedback for college drinking prevention: A randomized clinical trial. *Journal of Consulting and Clinical Psychology, 75,* 285–293.

Larimer, M. E., Turner, A. P., Anderson, B. K., Fader, J. S., Kilmer, J. R., Palmer, R. S., & Cronce, J. M. (2001). Evaluating a brief alcohol intervention with fraternities. *Journal of Studies on Alcohol, 62,* 370–380.

Lee, C. M., Kaysen, D. L., Neighbor, C., Kilmer, J. R., & Larimer, M. E. (2009). *Feasibility, acceptability, and efficacy of brief interventions for college drinking: Comparison of group, individual, and web-based alcohol prevention formats.* Unpublished manuscript, Department of Psychiatry and Behavioral Sciences, University of Washington, Seattle, Washington.

Lee, C. M., Kilmer, J. R., Neighbors, C., Atkins, D. C., Zheng, C., Walker, D. D., & Larimer, M. E. (2013). Indicated prevention for college student marijuana use: A randomized controlled trial. *Journal of Consulting and Clinical Psychology, 81,* 702–709.

Lee, C. M., Neighbors, C., Kilmer, J. R., & Larimer, M. E. (2010). A brief, web-based personalized feedback selective intervention for college student marijuana use: A randomized clinical trial. *Psychology of Addictive Behaviors, 24,* 265–273.

Lynskey, M., & Hall, W. (2000). The effects of adolescent cannabis use on educational attainment: A review. *Addiction, 95,* 1621–1630.

Magill, M., Barnett, N. P., Apodaca, T. R., Rohsenow, D. J., & Monti, P. M. (2009). The role of marijuana use in brief motivational intervention with young adult drinkers treated in an emergency department. *Journal of Studies on Alcohol and Drugs, 70,* 409–413.

Marijuana Treatment Project Research Group. (2004). Brief treatments for cannabis dependence: Findings from a randomized multisite trial. *Journal of Consulting and Clinical Psychology, 72,* 455–466.

McCambridge, J., & Strang, J. (2004). The efficacy of single-session motivational interviewing in reducing drug consumption and perceptions of drug-related risk and harm among young people: Results from a multi-site cluster randomized trial. *Addiction, 99,* 39–52.

McCambridge, J., & Strang, J. (2005). Deterioration over time in effect of motivational interviewing in reducing drug consumption and related risk among young people. *Addiction, 100,* 470–478.

Miller, W. R., & Rollnick, S. (2013). *Motivational interviewing: Helping people change* (3rd ed.). New York: Guilford.

Monti, P. M., Barnett, N. P., Colby, S. M., Gwaltney, C. J., Spirito, A., Rohsenow, D. J., & Woolard, R. (2007). Motivational interviewing versus feedback only in emergency care for young adult problem drinking. *Addiction, 102,* 1234–1243.

Moore, B. A., Augustson, E. M., Moser, R. P., & Budney, A. J. (2005). Respiratory effects of marijuana and tobacco use in a U.S. sample. *Journal of General Internal Medicine, 20,* 33–37.

Morgan, T. J., White, H. R., & Mun, E. Y. (2008). Changes in drinking before a mandated brief intervention with college students. *Journal of Studies on Alcohol and Drugs, 69,* 286–290.

Mun, E. Y., de la Torre, J., Atkins, D. C., White, H. R., Ray, A. E., Kim, S.-Y., . . . The Project INTEGRATE Team. (2015). Project INTEGRATE: An integrative study of brief alcohol intervention trials for college students. *Psychology of Addictive Behaviors.*

Mun, E. Y., White, H. R., & Morgan, T. J. (2009). Individual and situational factors that influence the efficacy of personalized feedback substance use interventions for mandated college students. *Journal of Consulting and Clinical Psychology, 77,* 88–102.

Muthén, L. K., & Muthén, B. O. (1998–2014). *Mplus user's guide* (Version 7.2). Los Angeles, CA: Authors.

Noonan, W. C., & Moyers, T. B. (1997). *Motivational interviewing. Journal of Substance Use, 2,* 8–16.

O'Malley, P. M., Bachman, J. G., & Johnston, L. D. (1983). Reliability and consistency in self-reports of drug use. *International Journal of the Addictions, 18,* 805–824.

Pape, H., Rossow, I., & Storvoll, E. E. (2009). Under double influence: Assessment of simultaneous alcohol and cannabis use in general youth populations. *Drug and Alcohol Dependence, 101,* 69–73.

R Development Core Team. (2011). *R: A language and environment for statistical computing.* Vienna, Austria: R Foundation for Statistical Computing.

Ray, A. E., Kim, S.-Y., White, H. R., Larimer, M. E., Mun, E.-Y., Clarke, N., . . . The Project INTEGRATE Team. (2014). When less is more and more is less in brief motivational interventions: Characteristics of intervention content and their associations with drinking outcomes. *Psychology of Addictive Behaviors, 28,* 1026–1040.

Roy-Byrne, P., Bumgardner, K., Krupski, A., Dunn, C., Ries, R., Donovan, D., . . . Zarkin, G. A. (2014). Brief intervention for problem drug use in safety-net primary care settings: A randomized clinical trial. *Journal of the American Medical Association, 312,* 492–501.

Saitz, R., Palfai, T. P. A., Cheng, D. M., Alford, D. P., Bernstein, J. A., Lloyd-Travaglini, C. A., . . . Samet, J. H. (2014). Screening and brief intervention for drug use in primary care: The ASPIRE randomized clinical trial. *Journal of the American Medical Association, 312,* 502–513.

Semple, D. M., McIntosh, A. M., & Lawrie, S. M. (2005). Cannabis as a risk factor for psychosis: Systematic review. *Journal of Psychopharmacology, 19,* 187–194.

Solowij, N. (1998). *Cannabis and cognitive functioning.* New York, NY: Cambridge University.

Stephens, R. S., Roffman, R. A., & Curtin, L. (2000). Comparison of extended versus brief treatments for marijuana use. *Journal of Consulting and Clinical Psychology, 68,* 898–908.

Taylor, D. R., Poulton, R., Moffitt, T. E., Ramankutty, P., & Sears, M. R. (2000). The respiratory effects of cannabis dependence in young adults. *Addiction, 95,* 1669–1677.

Tucker, J. S., Ellickson, P. L., Orlando, M., Martino, S. C., & Klein, D. J. (2005). Substance use trajectories from early adolescence to emerging adulthood: A comparison of smoking, binge drinking, and marijuana use. *Journal of Drug Issues, 35,* 307–332.

Viechtbauer, W. (2010). Conducting meta-analyses in R with the metafor package. *Journal of Statistical Software, 36,* 1–48.

White, H. R., Labouvie, E. W., & Papadaratsakis, V. (2005). Changes in substance use during the transition to adulthood: A comparison of college students and their noncollege age peers. *Journal of Drug Issues, 35,* 281–306.

White, H. R., Mun, E. Y., & Morgan, T. J. (2008). Do brief personalized feedback interventions work for mandated students or is it just getting caught that works? *Psychology of Addictive Behaviors, 22,* 107–116.

White, H. R., & Rabiner, D. L. (Eds.). (2012). *College students drinking and drug use.* New York, NY: Guilford.

Woolard, R., Baird, J., Longabaugh, R., Nirenberg, T., Lee, C. S., Mello, M. J., & Becker, B. (2013). Project Reduce: Reducing alcohol and marijuana misuse: Effects of a brief intervention in the emergency department. *Addictive Behaviors, 38,* 1732–1739.

Yusuf, S., Peto, R., Lewis, J., Collins, R., & Sleight, P. (1985). Beta blockade during and after myocardial infarction: An overview of the randomized trials. *Progress in Cardiovascular Diseases, 27,* 335–371.