Alcohol, Marijuana, and Mood States in Young Women

Barbara W. Lex,* PhD, MPH

Margaret L. Griffin, PhD

Nancy K. Mello, PhD

Jack H. Mendelson, MD

Harvard-McLean Alcohol and Drug Abuse Research Center Belmont, Massachusetts

Abstract

Potential predictors of 8 Profile of Mood States (POMS) factor scores were examined for 30 young women (mean age = 26.4 years). Prospective data were obtained from diary questionnaires and POMS ratings submitted daily during 3 consecutive menstrual cycles. Behavioral and social variables (heavy versus light marijuana smoking, consumption of both marijuana and alcohol on a given day, stress, and sexual activity) were stronger mood factor predictors than temporal or biological variables (weekends or menstrual cycle phase). Heavy marijuana users consistently reported higher negative moods and lower positive moods than light marijuana users.

INTRODUCTION

Alcohol and marijuana are popular recreational drugs among young adults. Recent surveys indicate that approximately three-fourths of women aged 21 to



^{*}To whom reprints requests should be addressed at the Harvard-McLean Alcohol and Drug Abuse Research Center, McLean Hospital, 115 Mill Street, Belmont, Massachusetts 02178.

34 drink alcohol (Clark and Midanik, 1982; Wilsnack et al., 1986). Within the last decade, prevalence of marijuana smoking has increased among adults as cohorts of younger marijuana users have aged (Kozel and Adams, 1986). Among women aged 18 to 35 queried in a stratified household survey, 15% reported daily marijuana smoking for at least 1 month at some time in their lives (Miller et al., 1983), and similar marijuana use rates were reported in longitudinal studies (Kandel, 1980, 1984; Kandel et al., 1986).

The properties of marijuana that promote and maintain use are still poorly understood (see Maykut, 1985, for recent review of a broad range of marijuana effects). Behavioral science research suggests that proximal events may be of greater importance in maintaining substance abuse than factors that prompted initial consumption in youth (see Mello, 1986, for review). It has been hypothesized that desire for a change in mood regardless of the direction of change may account for polydrug use (Mello, 1983a). The historically common belief that drug abuse by drug-dependent persons is primarily perpetuated by motivation to avoid abstinence symptoms has been refuted by empirical studies (Mello, 1983a). In the case of marijuana, there have been only occasional reports of withdrawal symptoms after high-dose chronic use (Jones, 1983; Mendelson et al., 1984). Under free-choice marijuana acquisition conditions on a clinical research ward, only one female subject developed withdrawal signs after cessation of high-dose marijuana smoking (3.25 mg THC per kg body weight per day) (Mendelson et al., 1984).

Most early studies of determinants of marijuana effects accorded greater importance to shared beliefs and social expectations than to pharmacological actions (Cappell et al., 1973; Cappell and Pliner, 1974; Jones, 1971; Jones and Stone, 1970) (see Table 1). Men and women studied by Russell and Bond (1979) reported that their desire to smoke marijuana was more strongly evoked by images of pleasant social contexts than unpleasant settings. In a follow-up study, Kandel (1984) examined the effects of social influence on drug use and found that for young women, current marijuana consumption patterns were best predicted by drug use of spouses or friends. Although the social appeal of marijuana lies in self-inducement of altered mood states typically described as "stoned" or "high," it is increasingly recognized that acute drug effects on moods may be complex and elusive (Mello, 1983a). In a study of adolescents, Larson and co-workers (1984) used electronic paging devices to elicit randomized prospective reports of the social context of alcohol and marijuana use and associated mood states in 19 male and female high school students. Drinking alcohol alone or in combination with marijuana was associated with enhanced positive affect when "partying" in small (2-3 person) groups, and when used to forestall boredom, endure routine tasks, or generally ameliorate negative affect. No differences were documented for male and female subjects.

MOOD STATES IN YOUNG WOMEN

Many studies of variables that may influence alcohol use have similarly focused upon social and environmental factors (see Table 1). Some studies allege that people drink more alcohol to compensate for unpleasant moods (Nathan et al., 1971; Sutker et al., 1983), while others argue that alcohol use increases in an effort to amplify pleasant moods (Kalin, 1972; Russell and Bond, 1979). In recent laboratory studies, an acute dose of alcohol has been associated with positive moods and brief episodes of euphoria on the ascending limb of the blood alcohol curve (Lukas et al., 1986). In contrast, recent multidisciplinary studies have shown that chronic alcohol intoxication augments depression and anxiety (see Mello, 1983a, 1983b, for review).

In women residing in the community, social and biological variables can also influence moods across the menstrual cycle (Smith, 1975; Halbreich et al., 1983). In a sample of 67 women, day of the week and phase of the menstrual cycle were significantly related to negative moods (Rossi, 1980). Tuesdays and the early to mid-luteal menstrual cycle phase were associated with increased negative moods, while Fridays and the periovulatory menstrual cycle phase were associated with elevated positive moods (Rossi, 1980). The importance of temporal factors in women's cyclic mood changes has also been reported from a prospective study of 14 normally cycling women during 4 consecutive menstrual cycles (Strauss and Appelt, 1983). In addition, earlier analysis of data from the present sample provides evidence for effects of temporal variation in modulating biological factors. A prospective study of concordant marijuana and alcohol use (Lex et al., 1986) found that these subjects were least likely to use alcohol with or without marijuana on Tuesdays and most likely to engage in both sexual activity and concordant alcohol and marijuana use on Fridays through Sundays.

Marijuana use patterns also have been found to influence subjective mood states. Comparison of 12 male heavy marijuana users (20 to 30 times per month) with 12 male casual users (2 to 4 times per month) indicated that heavy users reported significantly greater hostility, anxiety, and depression during abstinence (Mirin et al., 1971). Alcohol use patterns also influenced sober mood states in female social drinkers (Birnbaum et al., 1983). Alcohol use was significantly related to depression and anger in sober states among 93 female social drinkers. A random sample of female subjects who abstained from alcohol for 6 weeks reported significantly lower depression, anger, and confusion scores than women who maintained their alcohol intake.

This report examines the effects of level of marijuana use (heavy versus light), marijuana and alcohol consumption patterns, stressful events, sexual activity, menstrual cycle phase, and day of the week on mood state ratings recorded by 30 young women while residing in the community. All subjects submitted prospective daily reports during 3 menstrual cycles. These data enabled us to assess the effects of specific social, behavioral, and biological variables on the 8 factors of the Profile of Mood States (POMS) (McNair et al., 1981).

Authors	Year	Year survey done	Type of substance	Type of subject	Patterns of use
Jones and Stone	1970	No data	Marijuana and alcohol	10 young adult men	Daily marijuana smokers
Jones	1971	No data	Marijuana	25 daily and 25 infrequent marijuana smokers; young adult men	Stable smoking patterns for previous 2 months
Nathan, O'Brien, and Norton	1971	No data	Alcohol	 4 alcoholic skid- row men; 4 nonalcoholic skid-row men 	Daily drinkers Daily drinkers
Kalin	1972	No data	Alcohol	149 male col- lege students	No data (ab- stainers ex- cluded)
Cappell, Kuchar, and Webster	1973	No data	Marijuana	12 male mari- juana smokers	Smoke mari- juana > 2 times per week
Cappell and Pliner	1974	No data	Marijuana	60 male mari- juana smokers	Frequent smokers $\overline{X} = 18.2$ mari- juana cigarettes per week; infrequent smokers: 2.3 mari- juana cigarettes per month

Imputed Effects and Reasons for Use of

RIGHTSLINK()

Usual context of use	Study methods; data collected	Study site	Pertinent findings	Limitations of comparison
In community	Subjective Drug Effect Ques- tionnaire (also cognitive-per- ceptual tests)	In laboratory, 9 test days	More euphoria fol- lowing marijuana smoking than alcohol drinking	Major: No women in study; possible fatigue factor
In community	Subjective Drug Effect Ques- tionnaire (also physiologic and cognitive-per- ceptual tests)	In laboratory 3 hours	Nonspecific symp- toms of mari- juana "high"; heavy marijuana smokers were "placebo" re- sponders	Major: No women in sample; labora- tory environment not specified
In public places ("street")	Access to alco- hol; Mood Adjea tive Checklist	18 days' access c- to alcohol during 33 days while on clinical research unit	Increased hostility, depression, anxiety, and consumption in alcoholics	Major: men only; small sample size; diagnostic criteria
No data	"Wet" and "dry" cocktail party experiments; TAT scores; amount alco- hol consumed	In simulated classroom and apart- ment set- tings	Alcohol increased (fantasy) thoughts of physical aggres- sion and sexual activity; de- creased fear	Major: drinking in simulated classroom and apartment set- tings; not com- pared to usual consumption; no women in study
In community	4 doses; Latin square design; marijuana po- tency rating; physical signs; cognitive-per- ceptual tests	In laboratory	Subjective in- sensitivity to pharmacological effects	Major: no women in study; labora- tory environment not specified
In community	2 X 2 X 3 fac- torial design; 3 doses; self- rating of mari- juana intoxica- tion; physical signs	In laboratory	Potency not line- arly correlated with subjective intoxication ratings	Major: no women; written ratings may have altered subjective re- sponse; laboratory environment not specified

Marijuana and Alcohol: Selected Empirical Studies

(continued)



Authors	Year	Year survey done	Type of substance	Type of subjects	Patterns of use
Russell and Bond	1979	No data	Marijuana and alcohol	75 women, 125 men: college students who used both alcohol and marijuana	\overline{X} 4.96 ± 3.14 alcoholic drinks per week \overline{X} 2.12 ± 2.45 marijuana cigar- ettes per week
Sutker, Libet, Allain, and Randall	1983	No data	Alcohol	21 women; 11 men: healthy social drinkers employed in medical center	\overline{X} = 0.79 oz/day
Kandel	1984	1980	Marijuana	Cohort of 616 men and 706 women inter- viewed in high school in 1971	Abstainers through daily users
Larson, Csik szent- mihalyi, and Freeman	1984	No data	Alcohol and marijuana	12 male, 7 fe- male high school students	No data given
Lukas, Mendelson Benedikt, and Jones	1986 ,	1985	Alcohol	18 male social drinkers	\overline{X} = 3 drinks per week



Usual context of use	Study methods; data collected	Study site	Pertinent findings	Limitations of comparison
In community	Questionnaire responses to slides of dif- ferent unpleas- ant vs pleasant environments; self-reports of general emotion levels	Experiment in psychology laboratory	Desire for alcohol and for mari- juana associated with exposure to pleasant settings and moods	Major: study group size varied (2-20 persons); no substance administered
In community	Daily diaries; Multiple Af- fect Adjective Checklist	Usual locations; self-monitor- ing for 2 cycles or 60 days	Normally cycling women reported more negative moods, more drinking to re- lieve tension and depression during menstruation	Minor: did not study problem drinkers
In community	2-hour long household interview	In subject's home	For women, number of marijuana users in social networks increased with fre- quency of mari- juana use	Minor: omits some heavier using minority men from follow-up
In community	Signaled by paper to re- port experience	Several loca- tions in community	Alcohol on week- ends, at parties; marijuana throughout the week in multiple environments Alcohol, positive moods; mari- juana negative moods but more motivation	Major: drug use not the purpose of the study; subjects could shut off their pager and were reported to do so while using alcohol or mari- juana
In community	0.347 g/kg; 0.695 g/kg; or placebo	In laboratory	Integrated BAL, EEG, and con- tinuous subjec- tive recording device data Detected transient episodes of "eu- phoria" on ascend- ing limb of BAL curve; more pro- nounced at higher dose	Minor: no women in study

METHODS

Subjects

Thirty female volunteers aged 21 to 36 (\overline{X} = 26.4 years) were recruited by newspaper advertisements and provided informed consent for paid participation in a prospective study of marijuana smoking effects. All subjects were selected following complete physical and mental status examinations and laboratory studies. No subject had a current or past history of drug or alcohol abuse, was pregnant or lactating, or had a recent history of amenorrhea or other menstrual cycle disturbance. All subjects' menstrual cycles were of normal length (\overline{X} = 30.9 ± 4.4 days) (cf. Pritchard and MacDonald, 1976), and reports of psychological and somatic distress during menses were minimal (Griffin et al., 1986). No subject had been engaged in treatment for psychological disorders or had a history of psychological disorder as rated by the SADS-L (Endicott and Spitzer, 1978). Responses to preliminary screening questionnaires indicated that subjects typically were single, nulliparous women with some college education and that their experience with drugs other than marijuana and alcohol was infrequent. Subjects admitted to the study had similar background characteristics, but self-reported marijuana smoking frequency ranged from a few times per month to several times per day, and self-reported alcohol drinking ranged from once per month to once per day. During their participation in the study, 14 subjects were employed, 5 were intermittently employed, 5 remained unemployed, and 6 were students. Table 2 presents additional background variables for all subjects.

Procedure

All subjects completed daily diary questionnaires that monitored use of alcohol, marijuana, and all other drugs; occurrence of unusual events; frequency of sexual activity with partners, menstrual cycle phase, and 8 menstrual distress syndromes; and 8 mood factors. Subjects began daily reporting on the first day of menstruation following acceptance into the study and continued to record responses on each day for 3 consecutive menstrual cycles. Subjects obtained their own supplies of marijuana and alcohol. Each subject reported the total number of marijuana cigarettes (or other marijuana compounds) smoked and the total number and specific type of alcoholic beverages consumed (beer, wine, or other drinks). Data were recorded each evening before retiring and completed questionnaires were mailed daily to the investigators. This study reports relationships between the 8 mood factors and alcohol drinking, marijuana smoking, unusual events, sexual activity, day of the week, and menstrual cycle phase.

Mood was assessed each day with the Profile of Mood States (POMS), a simple adjective checklist comprised of 72 items grouped into 8 factor-analytic-

Table 2

			Range	Mean		SD
Age			21-36	26.4		4.4
Years education			8-21	14.5		5.9
Marijuana use (times last me	onth ^a)		5-40	15.0		10.2
Alcohol use (times last mon	th ^a)		2-20	7.0		3.7
Years regular marijuana use			2-15	7.4		3.3
Age began regular alcohol u	se		10-31	26.4		4.3
Total years alcohol use			1-15	7.7		3.4
Percent lifetime using alcoh	ol		3-52	29%		11%
Age began regular alcohol u	se		14-30	19.2		3.8
Total years marijuana use			3-15	7.2		3.2
Percent lifetime using marij	uana		3-46	27%		11%
	N	%			N	%
Ethnicity			Marijuana	smoking contexts		
White	27	9 0.0	Alone:			
Black	3	10.0	Yes		2	6.7
Marital status			No		11	36.7
Married	3	10.0	With ma	te:		
Single	23	76.7	Yes		3	10.0
Divorced	4	13.3	No		27	90.0
Religion			With frie	ends		
Protestant	8	26.6	Yes		30	100.0
Roman Catholic	7	23.3	With sibl	ling:		
Jewish	5	16.7	Yes		16	53.3
Other	3	10.0	No		14	46.7
None	7	23.3	With roo	mmate:		
Usual occupation			Yes		14	46.7
Clerk/technician	4	13.3	No		16	53.3
Homemaker	1	3.3	Mate smok	es marijuana		
"White-collar" worker	12	40.0	Yes		15	50.0
Service worker	7	23.3	No		15	50.0
Student	6	20.0	Tobacco u	se		
Living arrangements			Currently	y nonsmoker	9	30.0
Both parents	3	10.0	<.5 pack	k/day	10	33.3
Other relative	2	6.7	.5 to 1 pa	ck/day	6	20.0
Spouse	2	6.7	>1 pack	/day	5	16.7
Male friend	7	23.3				
Female friend	6	20.0				
Male and female friends	3	10.0				
Alone	7	23.3				

Background	Variables	of	Female	Marijuana	Smokers
	(N =	30) subject	s)	

^aMinimum frequency of use in the 30 days prior to admission to the study.

ally derived subscales (friendliness, tension, elation, anger, depression, fatigue, confusion, and vigor) which have been found sensitive to drug effects in diverse populations (McNair et al., 1981). Responses to each item were elicited on a 5-point scale ranging from 0 (not at all) to 4 (extremely). Subjects responded to each item in answer to the question "How did you feel today?" Subjects also indicated whether they had engaged in any sexual activity during the 24-hour reporting interval, and whether any unusually good or bad event had occurred on that day. According to widely used stressful life event scales from the early work of Holmes and Rahe (1967) to the present (Bloom, 1985), occurrence of unusual events, whether desirable or undesirable, is considered stressful.

Two different marijuana smoking quantity-frequency patterns were reported for these subjects (t = 4.93; p < .005) (Lex et al., 1986). The 15 women who smoked an average of 1.5 or more marijuana cigarettes on marijuana smoking days were defined as heavy marijuana users. As a group, heavy users smoked an average of 3.0 ($\pm 2.3 SD$) marijuana cigarettes on days of marijuana smoking, while women who were classified as light marijuana users smoked an average of 0.9 ($\pm 0.7 SD$) marijuana cigarettes on days of marijuana smoking. Overall, the maximum number of marijuana cigarettes smoked per day of marijuana user ranged from 4 to 17 for heavy users and from 1 to 6 for light users. The percentage of total study days on which marijuana was smoked ranged from 18% to 99% for heavy users and from 13% to 97% for light users.

RESULTS

The 30 women who participated in this study should have completed a total of 2,741 daily diary questionnaires during 3 consecutive menstrual cycles. A total of 2,715 daily diaries were submitted. Thus, only 26 diaries or 0.9% of the total sample, were not completed. This report identifies relationships between the 8 POMS factors and 6 behavioral, social, and biological predictor variables (amount of marijuana smoked, combined alcohol and marijuana use, unusual events, sexual activity, day of the week, and menstrual cycle phase).

Means and standard deviations for all mood factors were examined for each subject to determine whether responses to the POMS factors varied over time. Variability observed among mood factor scores indicated that subjects' responses were not merely the result of acquiescence response bias. Mean values per subject for 6 mood factors (confusion, elation, fatigue, friendliness, tension, and vigor) ranged across 85% of all possible scores, and ranges for depression and anger, respectively, accounted for 70% and 79% of all possible scores.

Correlational Analyses

The overall mean number of marijuana cigarettes smoked per day across the 3 menstural cycles by heavy users was 2.1 (\pm 2.4 SD) and by light users was



Fig. 1. POMS mood factor rating scores for heavy versus light marijuana users. Numbers below columns indicate possible ranges of scores. Displayed are means and standard errors of the mean for each of 8 mood factors: *p < .05; **p < .001.

0.6 (\pm 0.7 SD). As shown in Fig. 1, heavy marijuana users recorded significantly lower average daily scores on positive moods (friendliness, elation, and vigor) and higher average daily scores on 3 out of 5 negative moods (confusion, fatigue, and anger).

Marijuana and alcohol were consumed the same day by heavy users on 40.6% of study days and by light users on 29.3% of study days. All subjects recorded significantly higher friendliness, vigor, and elation scores on days when they consumed both alcohol and marijuana, thus resembling the mood profile observed during heavy marijuana use (see Figs. 1 and 2). However, unlike the heavy marijuana use, days of consuming both alcohol and marijuana were associated with significantly lower fatigue and tension scores. Confusion, anger, and depression scores were unrelated to consumption patterns.

Unusual, or stressful, events occurred on 21.7% of all study days for 29 subjects (only 1 light user reported no days of unusual events). The relationship between reports of unusual events and POMS scores is shown in Fig. 3. Subjects who reported unusual events recorded significantly higher tension, confusion, fatigue, anger, and depression scores. Increased elation was positively associated

415

RIGHTSLINK4)



Fig. 2. POMS mood factor rating scores for days on which subjects consumed both alcohol and marijuana (n = 944) versus days on which subjects consumed either alcohol or marijuana (n = 1,173). Numbers below columns indicate possible ranges of scores. Displayed are means and standard errors of the mean for each of 8 mood factors: *p < .05; ***p < .0001.

with unusual events, but scores for friendliness and vigor were unaffected by unusual events.

Sexual activity occurred on 28.1% of all study days for 24 subjects (6 subjects reported no sexual activity with a partner) and did not differentiate heavy from light users. All 3 positive moods of friendliness, elation, and vigor increased significantly on days of sexual activity, while 4 out of 5 negative moods (tension, anger, fatigue, and depression) decreased significantly on days of sexual activity.

Menstrual, follicular, periovulatory, early to mid-luteal, and premenstrual phases of the menstrual cycle were examined in relation to POMS scores. When compared to the remaining phases of the menstrual cycle, only the menstrual phase was significantly related to lower vigor scores and higher fatigue and depression scores.

Days of the week were examined as weekdays (Mondays through Thursdays) or weekends (Fridays through Sundays), since responses varied little within each of those 2 categories. Subjects were significantly more likely to consume both alcohol and marijuana on weekends. All 3 positive moods of friendliness, elation, and vigor were significantly higher on weekends than on weekdays,



Fig. 3. POMS mood factor rating scores for subjects study days on which subjects reported "unusual events" versus "no unusual events." Numbers below columns indicate possible ranges of scores. Displayed are means and standard errors of the mean for each of 8 mood factors: *p < .05; **p < .001.

while only the negative mood of tension was significantly lower on weekends than on weekdays.

Multiple Regression Analyses

Although each selected predictor variable showed a relationship with one or more of the 8 POMS mood factors, multiple regression analysis illuminated the combined interaction effects of all 6 predictor variables for each mood. The predicted effect of each predictor variable on the 8 POMS mood factors is shown in Table 3. The multiple regression analysis utilized the hierarchical inclusion method (Nie et al., 1975). Each predictor variable was chosen because it had shown a statistically significant relationship with one or more of the 8 POMS factors. Regression equations for predicting each POMS factor score (rows) can be constructed by using the constants and regression coefficients (Bs) for the 6 predictor variables (columns) presented in Table 3. Aggregate means and standard deviations and R^2 values for each of the 8 mood factors are presented in the far-right columns. Subst Use Misuse Downloaded from informahealthcare.com by Mcgill University on 11/17/14 For personal use only.

Table 3

A Model to Predict the Effect on Mood States of Heavy Versus Light Marijuana Use, Alcohol and/or Marijuana Consumption, Unusual

Events, Sexual Activity, Menstrual Cycle Phase, and Weekdays (N = $30)^{a}$

			Regre	ssion coeffic	ients (Bs)				
Profile of Mood States Item (possible range)	Constant	Heavy user ^b	Consume both ^c	Unusual events ^d	Sexual activity ^e	Menses ^f	Weekday ^g	$\overline{X} \pm SD$	R
Friendly (0-32)	16.6	-2.6	+1.5	1	+1.0	ł	1	13.4 ± 5.8	.27
Vigor (0-32)	12.3	-2.3	+1.3	I	+1.1	1	I	9.5±6.0	.23
Elation (0-24)	8.0	-0.7	I	I	+1.0	I	9.0-	6.7 ± 4.0	.16
Tension (0-36)	5.0	+0.5	-1.0	+1.9	i	I	ł	5.7 ± 4.2	.20
Confusion (0-28)	2.9	+1.1	I	+1.3	ł	I	1	4.8 ± 3.4	21
Fatigue (0-28)	2.0	8 .0+	-1.0	ł	I	+1.1	1	3.3 ± 4.6	.20
Anger (0-48)	0.7	6.0+	I	+2.2	I	ł	I	2.5 ±4.5	.21
Depression (0-60)	I	1	1	ų	1	I	1	2.7 ± 4.7	.21

^aFor all F ratios (and the correlation coefficient, for depression), p < .001. bHeavy marijuana users were compared to light marijuana users.

^cDays of consuming both alcohol and marijuana were compared to all other days. dDays of unusual events were compared to days of no unusual events.

^eDays of sexual activity were compared to days of no sexual activity.

Menstrual cycle phase was compared to the remaining cycle days.

EMondays through Thursdays were compared to Fridays through Sundays. $h_F = .21$ for depression with unusual events.

Multiple regression analysis requires assessment of the extent to which predictor variables are intercorrelated, that is, show multicollinearity. Predictor variables that were significantly related to a particular mood but which were not included in the final regression equation were highly correlated with more powerful predictor variables. Adding those variables to the regression equation did not increase the explained variance (R^2) . As a result, the multiple regression models presented in Table 3 minimize the information needed to predict moods. Thus multiple regression models proved to be more parsimonious than a series of correlational analyses.

As noted, in this sample marijuana user type and marijuana and alcohol consumption patterns were highly interrelated. Accordingly, it is not surprising that in the regression equation the explanatory power of marijuana user type is sufficiently strong to diminish effects of the additional contribution of consumption pattern to overall explained variance. For example, a significant association had been found between consumption pattern and elation. However, when marijuana user type is known, adding consumption pattern to the equation does not increase the explained variance for elation.

Drug Use Variables. Consumption behavior affected more mood states than the other variables studied. Being a *heavy marijuana user* influenced all POMS factors except depression. As shown in Table 3, heavy marijuana users had lower scores on all 3 positive moods (friendliness, elation, and vigor) and higher scores on 4 out of 5 negative moods (tension, anger, fatigue, and confusion).

Days of consuming both marijuana and alcohol were associated with changes in 4 moods. Scores for friendliness and vigor increased while scores for tension and fatigue decreased.

Behavioral Variables. Two behavioral variables were important predictors of moods on given days: sexual activity and stress, as indicated by occurrence of unusual events. Days of sexual activity did not affect negative moods but did increase all 3 of the positive moods (friendliness, elation, and vigor). In contrast, days of unusual events were unrelated to positive moods but increased 4 of the 5 negative moods (tension, depression, anger, and confusion).

Social Variables. Day of the week influenced only one mood. Elation was significantly lower on weekdays than weekends, but no other positive or negative moods were affected by this measure of socially demarcated time.

Biological Variables. According to the POMS, menstrual cycle phase exerted an influence on only one mood. An increase in fatigue was associated with the occurrence of *menstruation*, but the remaining cycle phases (follicular, periovulatory, early to mid-luteal, and premenstrual) were not important predictors of mood.

DISCUSSION

Relationships among 6 predictor variables and 8 POMS mood factors were analyzed with multiple regression techniques. Overall, the most powerful predictor of POMS mood factor scores during drug use was the quantity of marijuana used. Heavy marijuana users consistently reported significantly lower scores on the positive moods of friendliness, vigor, and elation; and significantly higher scores than light users on the negative moods of confusion, anger, fatigue, and tension. Decreased elation scores may also indicate that for women who smoke marijuana heavily, marijuana smoking becomes associated with decreased euphoria (cf. Mirin et al., 1971; Mello, 1983a) or that tolerance has developed to euphorigenic effects. However, absence of changes in depression scores for female heavy marijuana users differs from reported increased depression in male heavy marijuana users (Mirin et al., 1971) and was an unanticipated finding.

Interestingly, concordant marijuana and alcohol use was associated with reciprocal increases in 2 positive moods (friendliness and vigor) and decreases in 2 negative moods (fatigue and tension). Enhancement of subjective effects of marijuana intoxication by concurrent alcohol use has been reported previously (Hollister, 1976; Manno et al., 1971). Further, concurrent alcohol and marijuana use in convivial settings is likely to occur during leisure time, such as previously observed for weekend days (Larson et al., 1984; Lex et al., 1986), and may have additive effects on pleasant moods (cf. Manno et al., 1971).

The influence of setting and social context on moods cannot be discounted (cf. Lex et al., 1984). Results of a series of chronic marijuana self-administration studies involving groups of 3 or 4 of young men living in a homelike clinical research unit indicated that the prevailing mood of others in the environment was an important determinant of the subjective mood states of both heavy and casual marijuana smokers (Babor et al., 1974; Mendelson et al., 1976; Rossi et al., 1978). Possibly, mood of others is equally important for smoking outside the laboratory.

In addition to the drug use variables in the regression equation, two social variables proved to be important predictors of mood. Occurrence of unusual events (our measure of stress) was significantly associated with increases in negative moods and unrelated to positive moods. Four of the five negative moods (tension, depression, anger, and confusion) increased on days of stress. Hence stress had an important influence on negative moods but not on positive moods. A study by Bruns and Geist (1984), however, suggests that stress (both "good" and "bad" events) may affect adolescent females and males differently. Male and female high school students who used both alcohol and marijuana experienced a similar number of stressful life events, but females generally assigned significantly higher scores to the acute effects of stressors (Bruns and Geist, 1984). However, possible differential effects of menstrual cycle phase were not controlled.

Sexual activity was significantly related to all 3 of the positive moods (friendliness, elation, and vigor). Days on which sexual activity occurred were related to higher scores on positive moods compared to days without sexual activity. Concomitantly, sexual activity was unrelated to reports of negative moods. In our earlier analysis (Lex et al., 1986), sexual activity was found to occur most frequently on weekend days and in conjunction with increased concomitant marijuana and alcohol consumption.

Only fatigue, a primarily somatic POMS factor, varied significantly across the menstrual cycle, increasing during menses. Earlier study of Menstrual Distress Questionnaire (Moos, 1968) responses in this sample showed that menstruation had significant effects solely on somatic menstrual distress symptoms (Griffin et al., 1986). Results from other investigations are inconsistent, but, overall, retrospective studies are more likely to show somatic variation in cycle phase (Bruce and Russell, 1962; Moos et al., 1969; Parlee, 1980) than prospective studies (viz. Bruce and Russell, 1962; Rogers and Harding, 1981; Swandby, 1981; Watson and Robinson, 1965 for somatic symptoms).

The finding that socially demarcated time was significantly associated with elation scores also corroborates previous research. Both men and women experienced significantly increased positive moods on weekends (Rossi and Rossi, 1977). Further, positive moods were found to be more strongly related to day of the week than negative moods (Rossi, 1980). In addition, our finding that several variables (stress, sexual activity, and weekends) affect only negative or only positive moods contradicts the notion that negative moods are inversely related to positive moods (cf. Lorr, McNair, and Fisher, 1982).

The 30 women who provided daily records for this study cannot be considered a representative sample of all female marijuana smokers. Instead, they were volunteers selected for good physical and mental health. The prospective study design, relatively unobtrusive methods of data collection from persons residing in the community, and exceptionally high response rate all constitute methodological strengths. In this study behavioral variables proved to be better predictors of both positive and negative moods than either temporal or biological variables. It is unclear whether this pattern would be observed in other samples of female marijuana smokers or in men. Further research using a prospective daily diary method could establish the relative contribution of behavioral, temporal, and biological variables in mood for heavy versus light marijuana smoking in larger, more representative samples, or in samples of women with identified psychological disorders.

ACKNOWLEDGMENT

This study was supported in part by grants DA 02905, DA 04059, DA 00101, and DA 00064 from the National Institute on Drug Abuse; and grants



AA 06252 and AA 06794 from the National Institute on Alcohol Abuse and Alcoholism, ADAMHA. Our thanks to Scott Segal, who prepared the manuscript.

REFERENCES

- BABOR, T., ROSSI, M., SAGOTSKY, G., and MEYER, R. Group Behavior: Patterns of smoking. In J. Mendelson, A. Rossi, and R. Meyer (eds.), *The Use of Marihuana: A Psychological and Physiological Inquiry*. New York: Plenum, 1974.
- BIRNBAUM, I., TAYLOR, T., and PARKER, E. Alcohol and sober mood state in female social drinkers. *Alcohol: Clin. Exp. Res.* 7: 362-368, 1983.
- BLOOM, B. Stressful Life Event Theory and Research: Implications for Primary Prevention. DHHS Publ. No. (ADM) 85-1385. Washington, DC: U.S. Government Printing Office, 1985.
- BRUCE, J., and RUSSELL, G.F.M. Premenstrual tension: A study of weight changes and balances of water, sodium, and potassium. Lancet 2: 267-271, 1962.
- BRUNS, C., and GEIST, C. Stressful life events and drug use among adolescents. J. Human Stress 10: 135-139, 1984.
- CAPPELL, H., and PLINER, P. Regulation of the self-administration of marihuana by psychological and pharmacological variables. *Psychopharmacologia* 40: 65-76, 1974.
- CAPPELL, H., KUCHAR, E., and WEBSTER, C. Some correlates of marihuana self-administration in man: A study of titration of intake as a function of drug potency. *Psychopharmacologia* 29: 177-184, 1973.
- CLARK, W., and MIDANIK, L. Alcohol use and alcohol problems among U.S. adults. In National Institute on Alcohol Abuse and Alcoholism (ed.), Alcohol Consumption and Related Problems. Alcohol and Health Monograph No. 1. DHHS Publ. No. (ADM) 82-1190. Washington, DC: U.S. Government Printing Office, 1982.
- ENDICOTT, J., and SPITZER, R. A diagnostic interview: The Schedule for Affective Disorders and Schizophrenia. Arch. Gen. Psychiatry 37: 837-844, 1978.
- GRIFFIN, M., MENDELSON, J., MELLO, N., and LEX, B. Marihuana use across the menstrual cycle. Drug. Alc. Depend. 18: 213-224, 1986.
- HALBREICH, U., ENDICOTT, J., and NEE, J. Premenstrual depressive changes: Value of differentiation. Arch. Gen. Psychiatry 40: 535-542, 1983.
- HOLLISTER, L. Interactions of Δ^9 -tetrahydrocannabinol with other drugs. Ann. NY Acad. Sci. 281: 212-218, 1976.
- HOLMES, T., and RAHE, R. The social readjustment rating scale. J. Psychosom. Res. 11: 213-218, 1967.
- JONES, R.T. Cannabis tolerance and dependence. In K.O. Fehr and H.O. Kalant (eds.), Cannabis and Health Hazards. Toronto: Addiction Research Foundation, 1983.
- JONES, R.T. Tetrahydrocannabinol and the marihuana-induced social "high," or the effects of the mind on marihuana. Ann. NY Acad. Sci. 191: 155-165, 1971.
- JONES, R.T., and STONE, G. Psychological studies of marihuana and alcohol in man. Psychopharmacologia 18: 108-117, 1970.
- KALIN, R. Social drinking in different settings. In D. McClelland, W. Davis, R. Kalin, and E. Wanner, (eds.), *The Drinking Man.* New York: Free Press, 1972.
- KANDEL, D. Drug and drinking behavior among youth. Ann. Rev. Soc. 6: 235-283, 1980.
- KANDEL, D. Marihuana users in young adulthood. Arch. Gen. Psychiatry 41: 200-209, 1984.

- KANDEL, D., DAVIES, M., KARUS, D., and YAMAGUCHI, K. The consequences in young adulthood of adolescent drug involvement. Arch. Gen. Psychiatry 43: 746-754, 1986.
- KOZEL, N., and ADAMS, E. Epidemiology of drug abuse: An overview. Science 234: 970-974, 1986.
- LARSON, R., CSIKSZENTMIHALYI, M., and FREEMAN, M. Alcohol and adolescents' daily lives: A random sample of experience. Int. J. Addict. 19: 367-381, 1984.
- LEX, B.W., GRIFFIN, M., MELLO, N.K., and MENDELSON, J.H. Concordant alcohol and marihuana use in women. *Alcohol* 3: 193-200, 1986.
- LEX, B.W., MENDELSON, J.H., BAVLI, S., HARVEY, K., and MELLO, N.K. Effects of acute marihuana smoking on pulse rate and mood states in women. *Psychopharma*cology 84: 178-187, 1984.
- LORR, M., MC NAIR, D.M., and FISHER, S. Evidence for bipolar mood states. J. Personal. Assess. 46: 432-436, 1982.
- LUKAS, S.E., MENDELSON, J.H., BENEDIKT, R., and JONES, B. EEG alpha activity increases during transient episodes of ethanol-induced euphoria. *Pharmacol. Biochem. Behav.* 25: 889-895, 1986.
- MANNO, J., KIPLINGER, G., SCHOLZ, N., and FORNEY, R. The influence of alcohol and marihuana on motor and mental performance. Clin. Pharm. Ther. 12: 202-211, 1971.
- MAYKUT, M.O. Health consequences of acute and chronic marijuana use. Prog. Neuro-Psychopharmacol. Biol. Psychiat. 9: 209-238, 1985.
- MC NAIR, D., LORR, M., and DROPPLEMAN, L. Profile of Mood States. San Diego, CA: Educational and Industrial Testing Service, 1981.
- MELLO, N.K. A behavioral analysis of the reinforcing properties of alcohol and other drugs in man. In B. Kissin and H. Begleiter (eds.), *The Pathogenesis of Alcoholism: Biological Factors*. New York: Plenum Press, 1983a.
- MELLO, N.K. Drug use patterns and premenstrual dysphoria. In B. Ray and M. Braude (eds.), Women and Drugs: A New Era for Research. Research Monograph No. 65. DHHS Publ. No. (ADM)86-1447. Rockville, MD: National Institute on Drug Abuse, 1986.
- MELLO, N.K. Etiological theories of alcoholism. In N. Mello (ed.), Advances in Substance Abuse, Vol. 3. Greenwich, CT: JAI Press, 1983b.
- MENDELSON, J.H., BABOR, T.F., KUEHNLE, J.C., ROSSI, A.M., BERNSTEIN, J., MELLO, N.K., and GREENBERG, I. Behavioral and biologic aspects of marihuana use. Ann. NY Acad. Sci. 282: 186-210, 1976.
- MENDELSON, J.H., MELLO, N.K., LEX, B.W., and BAVLI, S. Marihuana withdrawal syndrome in a woman. Am. J. Psychiatry 141: 1289-1290, 1984.
- MILLER, J., CISIN, I., GARDNER-KEATON, H., HARRELL, A., WIRTZ, P., ABELSON, H., and FISHBURNE, P. National Survey on Drug Abuse: Main Findings 1982. Washington, DC: U.S. Government Printing Office, 1983.
- MIRIN, S., SHAPIRO, L., MEYER, R., PILLARD, R., and FISHER, S. Casual versus heavy use of marijuana: A redefinition of the marihuana problem. Am. J. Psychiatry 127: 1134-1140, 1971.
- MOOS, R. The development of a menstrual distress questionnaire. *Psychosom. Med.* 30: 853-867, 1968.
- MOOS, R., KOPELL, B., MELGES, F., YALOM, I., LUNDE, D., CLAYTON, R., and HAMBURG, D. Fluctuations in symptoms and moods during the menstrual cycle. J. Psychosom. Res. 13: 37-44, 1969.
- NATHAN, P., O'BRIEN, J., and NORTON, D. Comparative studies of the inter-personal and affective behavior of alcoholics and nonalcoholics during prolonged experimental

drinking. In J.H. Mendelson and N.K. Mello (eds.), Recent Advances in Studies of Alcoholism. Washington, DC: U.S. Government Printing Office, 1971.

- NIE, N., HULL, C., JENKINS, J., STEINBRUNNER, K., and BENT, D. Statistical Package for the Social Sciences, 2nd ed. New York: McGraw-Hill, 1975.
- PARLEE, M. Positive changes in moods and activation levels during the menstrual cycle in experimentally naive subjects. In A. Dan, E. Graham, and C. Beecher (eds.), *The Men*strual Cycle, Vol. 1: A Synthesis of Interdisciplinary Research. New York: Springer, 1980.
- PRITCHARD, J., and MAC DONALD, P. Williams Obstetrics, 15th ed. New York: Appleton-Century-Crofts, 1976.
- ROGERS, M., and HARDING, S. Retrospective and daily menstrual distress measures in men and women using Moos's instruments (Form A and T) and modified versions of Moos's instruments. In P. Komnenich, M. McSweeney, J. Noack, and N. Elder (eds.), *The Menstrual Cycle*, Vol. 2: *Research and Implications for Women's Health*. New York: Springer, 1981.
- ROSSI, A. Mood cycles by menstrual month and social week. In A. Dan, E. Graham, and C. Beecher (eds.), *The Menstrual Cycle*, Vol. 1: A Synthesis of Interdisciplinary Research. New York: Springer, 1980.
- ROSSI, A., and ROSSI, P. Body time and social time: Mood patterns by menstrual cycle phase and day of week. Soc. Sci. Res. 6: 273-308, 1977.
- ROSSI, A.M., KUEHNLE, J.C., and MENDELSON, J.H. Marihuana and mood in human volunteers. *Pharmacol. Biochem. Behav.* 8: 447-453, 1978.
- RUSSELL, J., and BOND, C. Beliefs among college students on settings and emotions conducive to alcohol and marijuana use. Int. J. Addict. 14: 977-986, 1979.
- SMITH, S.L. Mood and the menstrual cycle. In E.J. Sachar (eds.), *Topics in Endocrinology*. New York: Grune and Stratton, 1975.
- STRAUSS, B., and APPELT, H. Psychological concomitants of the menstrual cycle: A prospective longitudinal approach. J. Psychosom. Obst. Gynaecol. 24: 215-220, 1983.
- SUTKER, P., LIBEL, J., ALLAIN, A., and RANDALL, C. Alcohol use, negative mood states, and menstrual cycle phases. *Alcohol: Clin. Exp. Res.* 7: 327-331, 1983.
- SWANDBY, J. A longitudinal study of daily mood self-reports and their relationship to the menstrual cycle. In P. Komenich, M. McSweeney, J. Noack, and N. Elder (eds.), The Menstrual Cycle. Vol. 2: Research and Implications for Women's Health. New York: Springer, 1981.
- WATSON, P., and ROBINSON, M. Variations in body-weight of young women during the menstrual cycle. Br. J. Nutrition 19: 237-248, 1965.
- WILSNACK, S., WILSNACK, R., and KLASSEN, A. Epidemiological research on women's drinking, 1978-1984. In Division of Extramural Research, National Institute on Alcohol Abuse and Alcoholism, Women and Alcohol: Health-Related Issues. Research monograph No. 16. DHHS Publ. No. (ADM) 86-1139. Rockville, MD: National Institute on Alcohol Abuse and Alcoholism, 1986.