Substance Use & Misuse, 40:1525–1537

ISSN: 1082-6084 (print); 1532-2491 (online)
DOI: 10.1081/JA-200066866

Taylor & Francis
Taylor & Francis Group

Patterns of Simultaneous Polysubstance Use in Canadian Rave Attendees

SEAN P. BARRETT,[1] SAMANTHA R. GROSS,[2]
ISABELLE GARAND,[1] AND ROBERT O. PIHL[1]

[1]Department of Psychology, McGill University, Montreal, Quebec, Canada
[2]National Addiction Centre, Institute of Psychiatry, London, United Kingdom

The aim of this study was to examine rave-related polydrug drug use and to determine if patterns of substance use were associated with previous rave attendance. One hundred and eighty-six rave attendees (50% female) representing a wide range of ages (16 to 47 years; mean = 23.5, sd = 5.15) and levels of rave attendance experience (1 to 400 events) completed structured interviews in Montreal, Canada between November 2002 and September 2003 about their rave attendance patterns and their use of various licit and illicit substances at the most recently attended event. On average, participants reported using 2.5 different psychoactive substances (excluding tobacco) at the most recent event attended. Cannabis, alcohol, MDMA (ecstasy), amphetamine, cocaine, ketamine, and GHB were the most frequently reported substances, and details about their orders of administration, dosages, and patterns of co-administration are presented and discussed. The total lifetime number of raves attended by participants varied considerably (mean = 48.6; sd = 69.7; median = 25), and there was a positive correlation between the number events attended and number of substances used at the most recent event attended ($p < 0.001$). Analyses revealed that individuals reporting the use of ketamine, GHB, and/or cocaine at the most recent event had attended significantly more events than nonusers even when controlling for various demographic variables. A subset of respondents ($n = 27$) completed a second interview to determine the reliability of their responses. Results indicated that respondents could reliably recall details about which drugs were used, the total doses administered, as well as order of drug administration.

Keywords polysubstance use; rave; MDMA; amphetamine; GHB; ketamine; cocaine; substance use patterns; substance use trends

Introduction

Numerous investigations conducted worldwide have documented high rates of illicit substance use among rave attendees (Lenton, Boys, and Norcross, 1997; Winstock, Griffiths, and Stewart, 2001; Gross et al., 2002; Tossmann, Boldt, and Tensil, 2001; Forsyth, 1996). Drugs such as 3,4-methylenedioxymethamphetamine (MDMA or ecstasy), amphetamine, and cannabis have consistently been identified as being frequently used within this population (Lenton, Boys, and Norcross, 1997; Gross et al., 2002; Tossmann, Boldt, and Tensil, 2001), and recent reports indicate that other substances such as gamma-hydroxybutyrate (GHB) and ketamine (e.g., Freese, Miotto, and Reback, 2002) are increasing in popularity. Evidence also suggests that rave-related drug use often occurs in a polysubstance context.

Address correspondence to Sean P. Barrett, Department of Psychology, 1205 Dr. Penfield Ave., McGill University, Montreal, Quebec, Canada, H3A 1B1. E-mail: barrett@ego.psych.mcgill.ca

For example, in an Australian sample, 80% of rave attendees reporting using any substance used multiple substances (Lenton, Boys, and Norcross, 1997), while 66% of respondents in a Scottish study (Riley et al., 2001) reported polysubstance use. This trend toward polysubstance use has generated concern due to the possibility that simultaneous multiple substance administration results in increased toxicity (e.g., Schifano et al., 2003). Despite the apparent prevalence and potential adverse consequences associated with polysubstance administration, little is known about the specific patterns of rave-related multiple drug use. In a study of British ecstasy users, Winstock, Griffiths, and Stewart (2001) documented high levels of lifetime ecstasy co-administration with various licit and illicit substances including alcohol, cannabis, and amphetamines. However, this study did not provide information about what substances were used concurrently with ecstasy at raves or on any particular occasion. In a recent American study, Fendrich et al. (2003) reported high levels of concurrent drug co-administration among "club" drug users (identified as MDMA, ketamine, Rohypnol, and/or GHB). However, this study did not differentiate among various "club" drugs and their use was not explicitly associated with rave attendance. Finally, in a large European investigation of the drug-taking patterns of rave attendees, over 90% of ecstasy users reported the simultaneous use of at least one additional psychoactive substance during their most recent administration of the drug (Tossmann, Boldt, and Tensil, 2001). However like other studies, this investigation did not delineate rave-specific ecstasy use, and polysubstance-use patterns involving drugs other than ecstasy were not reported. The purpose of the present investigation was to better delineate the patterns of simultaneous polysubstance use that are characteristic of rave attendance by documenting amount, order, and type of all substances consumed on a single occasion by a sample of rave attendees from Montreal, Canada.

Methods

1. Procedure

Participants were recruited between November 2002 and September 2003 through advertisements posted at rave venues and on Internet rave-related bulletin boards as well as by word of mouth from individuals already participating in the study. Subjects were eligible for inclusion if they had attended at least one rave in the preceding 6 months and resided in the greater metropolitan area of Montreal, Canada. All participants were assured that the information they provided would remain strictly confidential and were paid $10 Canadian for their time. Interviews took approximately 30–40 minutes to complete and were conducted by two of the authors (SPB and IG). Prior to the beginning of the study, each interviewer had completed training in structured interview techniques and each had experience in using the "time-line follow back method" (Sobell and Sobell, 1996) of delineating patterns of substance use.

2. Structured Interview

The structured interview collected details about the participants' demographic characteristics as well as their "Rave" attendance patterns, including age of first attendance and an estimation of total number of events attended. In addition, detailed information was collected about drug and alcohol consumption at the most recently attended event using an interview format based on the time-line follow-back method (Sobell and Sobell, 1996). Participants were asked to think about the last event that they attended and provide details

about its date and location. They were then asked to recall all drugs consumed on that particular occasion (prior to, during, and after the event), including alcohol and tobacco. After spontaneously generating a list, participants were read a list of substances that they had not already mentioned and were asked if each substance was used at the time. The drugs included were alcohol, tobacco, cannabis, cocaine, amphetamine (speed, methamphetamine), MDMA (ecstasy), ephedrine, methylphenidate (Ritalin), amyl nitrate (poppers), GHB, ketamine (Special K), psilocybin (magic mushrooms), LSD, heroin, benzodiazepines, PCP, inhalants, mescaline, morphine, opium, Viagra, and "any other drug not already mentioned" (please specify). After listing every drug consumed, participants were asked to provide an ordered enumeration of their administration of all of the substances used on that occasion (excluding tobacco) as well as to provide details about the total amounts used of every substance. Additional details regarding the context of and reasons for specific patterns of drug administration were not routinely collected.

3. Test-Retest Reliability

In order to determine the reliability of participants' recollections of their rave-related substance use, a subset of the sample was contacted 24 to 72 hours following their initial interview and was asked to complete a second interview for the same event that they initially reported on. These participants were not randomly selected but rather represented the final 27 subjects interviewed. Although each of these participants were informed that they may be re-contacted to provide additional information, they were not told that the purpose of the second interview would be to determine the reliability of their initial responses.

Results

1. Sample Characteristics

A total of 186 (50% female) rave attendees completed the interview. Participants' age ranged from 16 to 47 years (mean = 23.5; sd = 5.15; median = 22; mode = 22) and the majority were Caucasian (87.9%). Education levels were fairly high among this group, with 87.6% having completed high school and 59.5% completing at least some post secondary education. Of the total subjects, 72.6% identified themselves as heterosexual, 14.5% homosexual, and 12.9% bisexual.

2. Rave Attendance

Subjects attended a rave for the first time on average at 18.9 (sd = 4.6) years of age. The total number of raves attended varied between 1 and 400, with a mean of 48.6 events (sd = 69.7), a median of 25 events, and a mode of 50 events; 31.7% attended 50 events or more. Of the respondents, 83.9% reported using drugs or alcohol "often" or "always" when they go to raves.

3. Number of Substances Used at the Most Recently Attended Rave

Participants' rave substance use varied considerably, ranging from zero to seven different substances (excluding tobacco) with a mean of 2.5 (sd = 1.2) different substances consumed.

While only 2.7% of participants reported no substance use and 17.2% reported the use of a solitary drug, approximately 80% reported polysubstance use.

4. Rave-Related Tobacco Use

Although 48.7% of participants identified themselves as regular daily smokers, 59.1% reported smoking tobacco at the most recent event attended. Concurrent tobacco use was reported in the majority of cases with every other type of drug reported (ranging from 61.5% of GHB users to 76.5% of cocaine users). However, because tobacco is typically considered to be a substance devoid of significant intoxicating properties (e.g., Perkins, 2002) and its use was typically continuous throughout an event, it was decided to exclude it from all subsequent analyses of polydrug-taking patterns.

5. Rave-Related Polysubstance Use

In order to begin to delineate the specific polydrug use patterns at the most recent rave event attended, we calculated the percentage of respondents who had used each drug as well as the percentage of these users who reported simultaneous use of each other drug. Table 1 presents this data for all substances used by at least 5% of the sample. Additional analyses were performed to determine the order of initial administration of each substance, the proportion of users administering the drug in multiple sessions, the total number of substances concurrently used with each drug, as well as the total average doses consumed (Table 2).

Cannabis was the most commonly used substance (n = 120, 64.2%) at the most recent rave attended, and in 97.5% of the cases at least one additional psychoactive substance was also administered. Cannabis was co-administered by the majority of users of all other types of substances reported, ranging from 65.9% of amphetamine users to 76.9% of GHB users (Table 1). As shown in Table 2, although it was frequently first administered toward the middle of the drug-taking sequence, in the majority of the cases (55%) cannabis was reported to be used in multiple sessions interspersed with other substance use. The average cannabis user reported smoking 1.4 (s.d = 1.2) grams over the course of the evening.

Alcohol was the next most frequently reported substance with 52.2% (n = 97) of the sample reporting use. In 88.7% of these cases it was used with a minimum of one additional psychoactive substance, although the frequency of concurrent alcohol use varied considerably across substances ranging from 15.4% of GHB users to 76.5% of cocaine users (Table 1). Alcohol was typically consumed near or at the beginning of the drug-taking sequence and in only 17 (17.6%) of the cases did its initial use follow other substance administration (Table 2).

MDMA and amphetamines were each used by approximately half of the sample, although 73.7% reported using at least one of these drugs. In close to 90% of the cases, each of these drugs was used in a polydrug context (Table 1). The most frequent drugs used with MDMA were cannabis (68.5%), amphetamines (48.4%), and/or alcohol (45.2%), while amphetamines were most often used with cannabis (65.9%) and MDMA (50.6%). As Table 2 illustrates, on average both amphetamine and MDMA were used with approximately two additional substances. Moreover, for both drugs, users typically used a single dose in a single administration.

Cocaine (9.1%), ketamine (8.6%), and GHB (7%) were each reported by fewer than 10% of the sample and in every case, each of these drugs was used in a polysubstance

Table 1
Patterns of substance use at the most recently attended rave[a]

Drug	Any use (%)	Percentage of users reporting concurrent use of each substance							
		Cannabis	Alcohol	MDMA	Amphetamine	Cocaine	Ketamine	GHB	None[b]
Cannabis	64.9	XXX	55.0	52.5	48.3	10.8	9.2	8.3	2.5
Alcohol	52.2	68.0	XXX	43.3	36.1	13.4	9.3	2.1	11.3
MDMA	50.0	68.5	45.2	XXX	48.4	9.8	9.7	8.6	9.7
Amphetamine	47.8	65.9	39.3	50.6	XXX	5.7	14.6	12.4	11.2
Cocaine	9.1	76.5	76.5	52.9	29.4	XXX	23.5	11.8	0
Ketamine	8.6	68.8	56.3	50.0	81.3	25.0	XXX	18.8	0
GHB	7.0	76.9	15.4	69.2	86.4	15.4	23.1	XXX	0

[a]Data is reported for all substances used by a minimum of 5% of the total sample (n = 186). The table presents the percentage of respondents reporting any use of each substance, the percentage of users of each drug reporting concurrent use of each other substance.
[b]Excluding tobacco.

Table 2
Order of administration, proportion of users administering substance in multiple sessions interspersed with other drug use, number of drugs co-administered, and total dosage for each substance used by a minimum of 5% of participants

Drug	Order of first administration	Multiple sessions	Number of drugs co-administered[b]	Estimated total dosage
	Mean (sd)	%	Mean (sd)	Mean (sd)
Cannabis	2.0 (1.0)	55.0	2.0 (1.1)	1.4 (1.2) grams
Alcohol	1.3 (0.7)	22.7	1.9 (1.2)	6.4 (5.8) drinks
MDMA	2.5 (1.0)	9.9	2.0 (1.2)	1.1 (0.6) pills
Amphetamine	1.9 (0.8)	20.2	1.9 (1.2)	1.1 (0.4) pills
Cocaine	2.9 (1.1)	41.2	2.8 (1.0)	0.6 (0.9) grams
Ketamine	3.1 (1.4)	18.8	3.1 (1.4)	0.4 (0.2) grams
GHB	3.1 (1.6)	30.8	2.9 (0.9)	1.7 (1.0) uses

[a]Excluding tobacco.

context (Table 1). Moreover, each of these drugs was typically consumed late in the drug taking sequence and in combination with approximately three other psychoactive substances (Table 2). The most frequently co-administered drugs with cocaine were alcohol (76.5%), cannabis (76.5%), and MDMA (52.9%). Ketamine was most often used with amphetamine (81.3%), cannabis (68.8%), alcohol (56.3%), and MDMA (50%), while for GHB, concurrent amphetamine (86.4%), cannabis (76.9 %), and/or MDMA (69.2 %) use were most frequently reported. It is interesting to note that a full 100% of GHB users reported the concurrent use of at least one stimulant drug (amphetamine, cocaine, ephedrine, methylphenidate, and/or MDMA), while 93.7% of ketamine users reported simultaneous stimulant use.

Substances reported by fewer than 5% of the sample and thus not included in Tables 1 and 2 were ephedrine (3.2%), psilocybic mushrooms (3.2%), LSD (2.7%), and methylphenidate (1.8%). In 100% of the cases each of these substances was used in conjunction with at least one other psychoactive substance. However, specific patterns of polydrug use involving these substances were not delineated due to the small number of respondents reporting their use.

6. Order of Drug Administration

In order to identify the specific temporal sequence of polydrug consumption, a series of Wilcoxon tests for related samples were performed on each possible drug pairing, including all of the substances noted in Tables 1 and 2. Because this resulted in 21 separate analyses, a family Bonferroni correction was used and the threshold for statistical significance was placed at $p = 0.002$. Analyses revealed that when alcohol was used in drug combinations that included any of cannabis, MDMA, amphetamine, or cocaine, its use reliably precedes the initiation of each other substance use (p's < 0.002). Moreover, a similar trend was also evident for alcohol use preceding ketamine ($p = 0.043$) use; however, a small sample size (nine cases) may have prevented this association from reaching the threshold for significance. Despite the high levels of drug mixing, there was only one other case where the relative order of drug administration was found to be reliable. When used in combinations that include MDMA, amphetamine use was found to reliably precede MDMA use ($p < 0.001$).

7. Relationship Between Rave Attendance and Drug Use

Using a Pearson's Correlation Coefficient, a significant positive relationship was identified between the total lifetime number of Rave events attended and the number of drugs used at the most recent event ($r = 0.259$, $p < 0.001$). In order to determine how the use of specific substances were related to level of rave attendance, a series of ANOVAs were performed with "total number of raves attended" as the dependent variable and with the independent variables being each drug reported by a minimum of 5% of respondents, while controlling for the possible effects of age, gender, and sexual orientation by including them as covariates (Table 3). Although no significant relationships were revealed between rave attendance and the use of alcohol, cannabis, amphetamine or MDMA, there were very strong associations between number of raves attended and the use of cocaine, ketamine, and GHB (p's < 0.001).

In order to further delineate the relationship between rave attendance and the use of cocaine, ketamine, and/or GHB at the most recent rave attended, odds ratios were calculated using a binary logistic regression model. In each case, number of raves attended, age, gender, and sexual orientation were used as potential predictors of the outcome variable, use or nonuse of the drug, and both chi-squared and Wald values were determined. Table 4 presents the results of these analyses. Because separate analyses were required for each substance, a family Bonferroni correction was used and the threshold for statistical significance was placed at $p = 0.017$. In each case, the number of raves attended remained the sole variable to reliably distinguish between those reporting use of the drug and those not. Moreover, odds ratios revealed that the probability of using each of these drugs at the most recent rave attended increased between approximately 9%–13% for every 10 raves attended (Table 4).

8. Test-Retest Reliability

The final 27 subjects (12 male, 15 female) interviewed were contacted by telephone 24 to 72 hours following their initial completion of the study and were again asked to recount the

Table 3

Mean (SD) number of raves attended by users of various substances and the relationship between substance use and level of rave attendance when controlling for various demographic variables ($n = 186$)

	Number of raves attended[a]		
Drug	Users	Nonusers	F[b]
Alcohol	51.1 (74.7)	46.1 (61.8)	.82
Cannabis	46.6 (64.0)	53.3 (77.2)	1.03
MDMA	46.1 (61.7)	51.3 (75.3)	.01
Amphetamine	60.6 (80.7)	37.8 (53.6)	1.6
Cocaine	107.8 (117.1)	42.9 (59.3)	19.7[c]
Ketamine	127.5 (111.7)	41.3 (58.4)	18.5[c]
GHB	132.8 (107.9)	42.3 (60.7)	17.8[c]

[a] Means (SD) were calculated separately for individuals reporting use of a particular substance at the most recently attended rave (users) and those not reporting use of that substance at the last rave (nonusers).

[b] All analyses of variance were performed with gender, age, and sexual orientation as covariates; ($df = 1, 181$).

[c] $P < 0.001$.

Table 4
Level of rave attendance predicts the probability of cocaine, GHB, and/or ketamine administration at the most recently attended event using logistic regression

Predictor variable	Chi squared χ^2	Wald Z	Odds ratio	95% Confidence interval for odds ratio
Cocaine				
Raves attended	9.44[a]	13.33[b]	1.013	1.006–1.021
Age	1.18	0.92	0.939	0.826–1.068
Gender	4.19	4.60	0.221	0.055–0.883
Sexual orientation	0.71	0.42	0.722	0.328–1.588
GHB				
Raves attended	12.81[b]	9.81[a]	1.010	1.004–1.016
Age	0.36	0.28	1.027	0.931–1.132
Gender	0.20	0.26	1.428	0.360–5.663
Sexual orientation	0.12	0.12	1.116	0.501–2.695
Ketamine				
Raves attended	14.84[b]	9.08[a]	1.009	1.003–1.016
Age	0.26	0.05	0.989	0.897–1.092
Gender	0.00	0.21	1.342	0.386–4.666
Sexual orientation	3.63	3.86	1.985	1.001–3.933

[a] $P < 0.017$.
[b] $P < 0.001$.

details of their drug taking for the same event they initially reported on. In 25 of the 27 cases (92.6%), participants reported the exact same series of substances during both interviews. Pearson's correlation coefficients were calculated to determine the consistency of reports for all drugs used by five or more subjects as well as for the doses reported, while Cohen's Kappa was used to determine the reliability of the ordinal drug-taking sequence data. These data are presented in Table 5. Pearson's correlations revealed very high correlations for all drugs tested (ranging from 0.87 to 1.0), suggesting that participants were consistent in their reports of what drugs were used on the particular occasion as well as in the dosages reported. Moreover, Cohen's Kappa values for drug order data generally indicated very good reliability with values ranging from 0.65 to 1.0.

Discussion

The present results are consistent with previous reports of high levels of drug mixing among rave attendees (e.g., Riley et al., 2001; Lenton, Boys, and Norcross, 1997) and suggest that simultaneous polysubstance use may be normative in this population. Approximately 80% of the present sample reported multiple substance administration at their most recently attended rave-event, and nearly 50% reported the concurrent use of three or more drugs. The use of multiple substances at raves is increasingly becoming a well-documented phenomenon; however, to our knowledge the present investigation is the first to delineate the specific patterns of drug administration associated with rave attendance. Moreover, this study also presents evidence that participants can reliably recount details about the type, order, and amount of all substances used on a specific occasion. While test-retest reliability data was only collected on a subset of participants ($n = 27$), analyses revealed that individuals were highly concordant in their reports and despite the modest sample size, the information provided was found to be highly reliable (Table 5).

Table 5
Test-retest reliability of participants' reports for substance use at the most recent rave attended (n = 27)

Drug	N	Pearson's correlation coefficient: substance used	Pearson's correlation coefficient: reported dose	Cohen's Kappa: order of administration
Alcohol	22	0.88[b]	0.98[b]	0.65[a]
Cannabis	18	1.0[b]	0.96[b]	0.84[b]
MDMA	14	0.93[b]	0.87[b]	0.89[b]
Amphetamine	8	0.92[b]	1.0[b]	0.81[b]
Cocaine	5	1.0[b]	1.0[b]	1.0[b]

[a] $P = 0.001$.
[b] $P < 0.001$.

Cannabis, the most commonly used substance by the present sample, was used almost exclusively in a polydrug context. It was reported to be co-administered by the majority of users of all other substances and in most cases, was used over multiple sessions interspersed with other drug administration. Given its frequent administration with substances from various pharmacological classes as well as its pattern of continuous administration, it is reasonable to assume that cannabis use is likely regarded as fairly benign activity among rave attendees. Although little is known about the effects of cannabis when it is co-administered with other substances, at least in the case of alcohol, cannabis has been demonstrated to produce additive intoxicating effects (e.g., Ramaekers et al., 2004). It should be noted however, that the solitary administration of even large doses of acute cannabis are generally not considered toxic (e.g., Grotenherman, 2003), and to our knowledge there are no conclusive reports of acute cannabis use contributing to another drug's toxicity.

Alcohol, the second most frequently reported substance was normally used at or near the beginning of the drug-taking sequence and did not usually continue following other substance administration. Because alcohol use typically preceded other drug administration, it is possible that its use may have increased the probability of other substance use, at least in some individuals. Alternatively, alcohol use may occur exclusively in the early stages of the drug-taking sequence due to more pragmatic reasons. Alcohol's availability is often limited or prohibited at many rave venues, and because its administration is more conspicuous than most other forms of substance use, its consumption may be limited to the time immediately prior to the event. Alcohol co-administration with substances such as MDMA (Hernandez-Lopez et al., 2002), cocaine (McCance-Katz, Kosten, and Jatlow, 1998), and methylphenidate (Barrett and Pihl, 2002) has been reported to augment euphoric drug effects, and it is possible that this may contribute to its propensity to be used concurrently with certain drugs. The practice of drug-alcohol co-administration has also generated considerable concern. Alcohol use with drugs such as cocaine (e.g., McCance-Katz, Kosten, and Jatlow, 1998) or methamphetamine (Mendelson et al., 1995) is thought to lead to increased toxicity, and co-administration with central nervous system (CNS) depressants such as GHB may produce lethal effects (e.g., Smith, Larive, and Romanelli, 2002). The present finding that alcohol is frequently administered prior to the use of drugs from various classes highlights the importance of continued research into the effects and consequences of alcohol-illicit drug co-administration.

Ecstasy and amphetamine also emerged as two of the most popular substances used by the sample, confirming previous reports that these are among the most commonly used drugs

by Canadian rave attendees (Gross et al., 2002). While nearly three-quarters of the sample reported using at least one of these substances, approximately half of the users of each drug reported using both. Interestingly, in cases where both drugs were used, amphetamine was found to reliably precede MDMA use, suggesting that order of administration may contribute to the positive effects that have been associated with the concurrent use of these drugs (Riley et al., 2001; Winstock, Griffiths, and Stewart, 2001). In most cases MDMA and/or amphetamine use were each limited to the administration of a single dose, a practice that presumably minimizes the probability of overdose. On the other hand, in the vast majority of cases, MDMA and amphetamine were used in a polysubstance context, which might increase the occurrence of adverse outcomes. Multiple substance use has been implicated in the majority of documented methamphetamine (see Mendelson et al., 1995) and MDMA (Schifano et al., 2003) related fatalities. However, because these drugs seem to be routinely used in a polydrug context, the clinical significance of such findings remain unclear.

A minority of participants reported the use of cocaine, ketamine, and/or GHB at the most recently attended rave. Each of these substances has been demonstrated to have toxic properties (e.g., Smith, Larive, and Romanelli, 2002; Freese, Miotto, and Reback, 2002; McCance-Katz, Kosten, and Jatlow, 1998), and the consequences associated with their use in a polydrug context remain largely uninvestigated. Individuals that used any of these drugs administered more substances concurrently and had attended significantly more raves relative to other participants. These findings are consistent with previous research on rave attendees that found that the use of any cocaine, ketamine, or GHB tended to occur relatively late in the course of "drug experimentation" and was most prominent among individuals that reported having extensive histories of drug use (Gross et al., 2002). Such results also raise the possibility that frequent rave attendance may lead to more dangerous drug-taking practices and suggest that prevention efforts should be directed toward individuals already immersed in "rave" subculture.

The present results should be interpreted in light of the following methodological limitations. First, because the participants were self-selected and the sample size was relatively modest, it is possible that the present results are not representative of population wide, rave-related polysubstance-use patterns. Although the rave attendees in the present sample represent individuals from a wide age rage (16–47 years) and level of rave experience (1–400), and the rates of polysubstance use reported were comparable to those obtained in different larger scale investigations using a variety of sampling techniques (e.g., Fendrich et al., 2003; Tossman, Boldt, and Tensil, 2001; Winstock, Griffiths, and Stewart, 2001), only a true random sample of rave attendees would ensure the generalizability of these results.

Second, because this study relied exclusively on retrospective recall, the accuracy of the information reported might be questioned. Previous research suggests that when appropriate interview methods are used that substance use self-report data can yield both reliable and valid results (e.g., Fals-Stewart et al., 2000; Sobell et al., 1996) in the present study a measure of test-retest reliability revealed that participants were highly consistent in their reports, suggesting a high degree of accuracy. However, the validity of the reports were not verified using objective drug detection methods and it remains possible that in some cases the extent of drug use may have been underreported (Fendrich et al., 2004). Finally, although the level and type of substance use on any particular occasion is likely related to numerous factors such as the availability of different substances, the presence or absence of drug-using peers, and the desire the achieve certain psychoactive effects (e.g., Sloboda, 2002), the present investigation did not systematically address contextual and motivational factors surrounding rave-related polysubstance use and such issues should be addressed in future investigations.

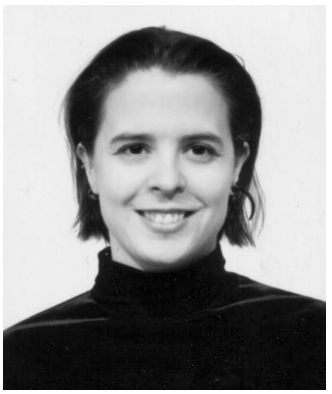
Acknowledgments

This research was supported by the Canadian Institutes of Health Research.

THE AUTHORS

Sean P. Barrett, Ph.D. (c), has a long-held interest in understanding different aspects of drug and alcohol addiction in humans. As a high school student he was the recipient of the ATTAC drug awareness award, and his interest in drugs and addictive processes has continued throughout his undergraduate and graduate training. As a graduate student at McGill, he has contributed to the completion of over 15 studies examining different aspects of human drug addiction, using a variety of research methods including neuroimaging techniques, neurotransmitter depletion, and structured clinical interviews. He is currently working as a clinical psychology intern at the Royal Victoria Hospital in Montreal and has accepted a position as an Assistant Professor in Adult Psychopathology at Dalhousie University in Halifax, Canada to begin in September 2005.

Samantha R. Gross, M.Sc., is a Doctoral Student and Senior Research Worker in the Addictions based at the Institute of Psychiatry, King's College London. Ms. Gross has a B.A. in psychology from McGill University, Quebec, where she examined trends in recreational drug use in the Canadian rave scene, as well as methods of assuring quality in mental health treatment. Her thesis research examines the organization of treatment, regulatory systems, and clinical outcomes for impaired healthcare professionals. Ms. Gross follows a systems approach in her work, and is currently interested in the evaluation and implementation of drug policy. In the U.K., she has co-authored documents published by the Department of Health and the Home Office, and has also worked on drug policy projects with academic and law enforcement organizations.



Isabelle Garand obtained her B.A. in psychology from McGill University in 2003. She is currently working as a research assistant at Montreal's Royal Victoria Hospital, and intends to pursue graduate studies in Clinical Psychology starting next year.

Robert O. Pihl, Ph.D., is a professor in the Departments in Psychology and Psychiatry at McGill University. Prof. Pihl's research coalesces around the perspective that differential susceptibility/etiology for a mental disorder is a function of variability in different motivational systems. Work is ongoing in four areas, a developmental study of a birth cohort of twins, investigations of populations at risk for "drug abuse," the assessment of drug effects, and clinical interventions with drug user using populations.

References

Barrett, S. P., Pihl, R. O. (2002). Oral methylphenidate-alcohol co-abuse. *J. Clin. Psychopharmacol*. 22(6):633–4.

Fals-Stewart, W., O'Farrell, T. J., Freitas, T. T., McFarlin, S. K., Rutigliano, P. (2000). The timeline followback reports of psychoactive substance use by drug-abusing patients: psychometric properties. *J. Consult. Clin. Psych*. 68(1):134–44.

Fendrich, M., Wislar, J. S., Johnson, T. P., Hubbell, A. (2003). A contextual profile of club drug use among adults in Chicago. *Addiction* 98(12):1693–703.

Fendrich, M., Johnson, T. P., Wislar, J. S., Hubbell, A., Spiehler, V. (2004). The utility of drug testing in epidemiological research: results from a general population survey. *Addiction* 99(2):197–208.

Forsyth, A. J. (1996). Places and patterns of drug use in the Scottish dance scene. *Addiction* 91(4):511–21.

Freese, T. E., Miotto, K., Reback, C. J. (2002). The effects and consequences of selected club drugs. *J. Subst. Abuse. Treat*. 23(2):151–6.

Gross, S. R., Barrett, S. P., Shestowsky, J. S., Pihl, R. O. (2002). Ecstasy and drug consumption patterns: Canadian rave population study. *Can. J. Psychiatry* 47(6):546–51.

Grotenherman (2003). Pharmacokinetics and pharmacodynamics of cannabinoids. *Clinical Pharmacokinetics* 42(4):327–60.

Hernandez-Lopez, C., Farre, M., Roset, P. N., Menoyo, E., Pizarro, N., Ortuno, J., Torrens, M., Cami, J., de La Torre, R. (2002). 3,4-Methylenedioxymethamphetamine (ecstasy) and alcohol interactions in humans: psychomotor performance, subjective effects, and pharmacokinetics. *J. Pharmacol. Exp. Ther*. 300(1):236–44.

Lenton, S., Boys, A., Norcross, K. (1997). Raves, drugs and experience: drug use by a sample of people who attend raves in Western Australia. *Addiction* 92(10):1327–37.

McCance-Katz, E. F., Kosten, T. R., Jatlow, P. (1998). Concurrent use of cocaine and alcohol is more potent and potentially more toxic than use of either alone—a multiple-dose study. *Biol. Psychiatry*. 44(4):250–9.

Mendelson, J., Jones, R. T., Upton, R., Jacob, P. (1995). Methamphetamine and ethanol interactions in humans. *Clin. Pharmacol. & Ther*. 57(5):559–68.

Perkins, K. A. (2002). Chronic tolerance to nicotine in humans and its relationship to tobacco dependence. *Nicotine & Tobacco Research* 4(4):405–22.

Ramaekers, J. G., Berghaus, G., van Laar, M., Drummer, O. H. (2004). Dose related risk of motor vehicle crashes after cannabis use. *Drug Alcohol Depend*. 73(2):109–19.

Riley, S. C., James, C., Gregory, D., Dingle, H., Cadger, M. (2001). Patterns of recreational drug use at dance events in Edinburgh, Scotland. *Addiction* 96(7):1035–47.

Schifano, F., Oyefeso, A., Corkery, J., Cobain, K., Jambert-Gray, R., Martinotti, G., Ghodse, A. H. (2003). Death rates from ecstasy (MDMA, MDA) and polydrug use in England and Wales 1996–2002. *Hum. Psychopharmacol*. 18(7):519–24.

Sloboda, Z. (2002). Changing patterns of "drug abuse" in the United States: connecting findings from macro- and microepidemiologic studies. *Substance Use Misuse* 37(8–10):1229–51.

Smith, K. M., Larive, L. L., Romanelli, F. (2002). Club drugs: methylenedioxymethamphetamine, flunitrazepam, ketamine hydrochloride, and gamma-hydroxybutyrate. *Am. J. of Health Syst. Pharm*. 59(11):1067–76.

Sobell, L. C., Brown, J., Leo, G. I., Sobell, M. B. (1996). The reliability of the Alcohol Timeline Followback when administered by telephone and by computer. *Drug Alcohol Depend*. 42(1):49–54.

Sobell, L. C., Sobell, M. B. (1996). *Alcohol Timeline Followback (TLFB) Users' Manual*. Toronto: Addiction Research Foundation.

Tossmann, P., Boldt, S., Tensil, M. D. (2001). The use of drugs within the techno party scene in European metropolitan cities. *Eur. Addict. Res*. 7(1):2–23.

Winstock, A. R., Griffiths, P., Stewart, D. (2001). Drugs and the dance music scene: a survey of current drug use patterns among a sample of dance music enthusiasts in the UK. *Drug Alcohol Depend*. 64(1):9–17.