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Psychosocial profiles of older adolescent MDMA users

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Abstract

Purpose: Using a case-control design, patterns of drug use, psychological symptoms, and behavioral characteristics associated with 3,4-methylenedioxymethamphetamine (MDMA) use were surveyed in a sample of older adolescents (median age 20). *Methods:* One hundred (42 MDMA users; 58 non-MDMA users) older adolescents were recruited using the "snowball" technique and interviewed regarding their use of MDMA and other drugs. The Brief Symptom Inventory (BSI), the Problem Oriented Screening Instrument for Teenagers (POSIT), the HIV/sexually transmitted diseases (STD) risk scale, and the Childhood Trauma Questionnaire (CTQ) were also administered. *Results:* MDMA users were more likely to use other substances, endorse more symptoms of psychological distress, and had more problems in functional lifestyle areas. They also reported more childhood experiences of physical abuse, emotional neglect, and physical neglect than non-MDMA users. MDMA users also reported more sexually risky behaviors. *Conclusions:* Occasional MDMA use among older adolescents was associated with polydrug use, multiple social difficulties, psychological symptoms, and health risk behaviors. Further research is warranted to understand the long term psychosocial consequences of chronic MDMA and polydrug usage.

Keywords: MDMA; Adolescents; Physical abuse; Neglect; Demographics

1. Introduction

Use of 3,4-methylenedioxymethamphetamine (MDMA or 'Ecstasy') has increased dramatically among young people in the United States and internationally. In a recent survey of 44,000 US high school students from 1996 to 2001, the use of MDMA among 12th graders had doubled from 6.1 to 11.7% (Johnston et al., 2001). Among US college students, in a nationally representative survey sample, the prevalence of past year MDMA use rose from 2.8 to 4.7% between 1997 and 1999 (Strote et al., 2002). In terms of international use, a recent review of studies including, Australia, Germany, and other European countries had estimates of lifetime MDMA use from 1% to a high of 13% of those sampled (Parrott, 2001).

This upward trend has prompted investigators to investigate cognitive, psychological, and neurological sequelae of MDMA use. MDMA is a serotonergic agonist and to a lesser extent a dopaminergic agonist (Parrott, 2001) and thus may affect each of these areas of functioning. First, cognitive deficits have been shown in MDMA users in several studies across several countries (McCann et al., 1999; Parrott et al., 1998; Gouzoulis-Mayfrank et al., 2000; Fox et al., 2001, 2002), as well as memory deficits (Rodgers, 2000; Morgan, 1999; Heffernan et al., 2001; Wareing et al., 2000; Rodgers et al., 2001). Also, based on serotonergic toxicity seen in animal studies (Ricaurte et al., 1988, 2000b), psychological outcomes may also be affected. Initially, published case studies showed poor psychological outcomes, ranging from depression (McGuire et al., 1994), and anxiety (Pallanti and Mazzi, 1992), to psychosis (Creighton et al., 1991; Series et al., 1994; Keenen et al., 1993). More recent research has found MDMA users to differ from comparison groups on a variety of psychological outcomes such as depression, phobic anxiety, anxiety, obsessive–compulsive symptoms, psychoticism (Parrott et al., 2000, 2001, 2002; Daumann et al., 2001; Curran and Travill, 1997; Parrott and Lasky, 1998; Dughiero et al., 2001), and impulsivity (Morgan, 1998). These studies suggest that MDMA may affect the serotonergic system of users such that disorders commonly affected by

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5-HT abnormalities will be more likely to occur (Naughton et al., 2000). A final area of focus in human studies has been the use of imaging techniques (Reneman et al., 2001). This research uses brain scanning methodologies to investigate differences in MDMA users from non-MDMA controls. Although methodologically limited due to the use of small sample sizes, these studies have generally shown that past MDMA use is related to serotonergic impairment (Reneman et al., 2000; Ricaurte et al., 2000a; McCann et al., 1998). Thus, empirical research thus far lends support to potential negative psychosocial outcomes as a result of MDMA use.

However, despite its increasing use and a proliferation of research studies demonstrating both short and long term negative effects of MDMA use, studies investigating the psychological, demographic, and personality characteristics of older adolescent MDMA users in the United States are lacking. The present study, a pilot study of club drug use among older adolescents, compared MDMA users with non-MDMA users on salient demographic and psychological characteristics in order to understand the personality profile of this growing population of young people.

Specifically, we hypothesized that MDMA users would have more negative consequences when compared to a non-MDMA drug using group. Based on prior research, it was expected that MDMA users would be more likely to use other drugs of abuse and to have impairments in functional areas of life, such as achievement and family functioning. Further, we hypothesized that MDMA use may be related to past trauma history, hypotheses that were tested with a brief self-report measure of childhood trauma. Finally, psychological outcomes were investigated with a measure similar to those utilized in other MDMA studies that would allow for analyses of these participants' level of psychological distress as well as provide a ready comparison to other international studies.

2. Methods

2.1. Participants

All participants were volunteer subjects recruited from an urban Cleveland neighborhood. The snowball technique of recruitment was utilized in which those who participate are asked to refer others who qualify for the study (Biernacki and Waldorf, 1981). Flyers asking volunteers to provide confidential information about club drug use, including a telephone number for responses, were also distributed in the vicinity. The flyer asked participants whether they had ever attended a rave, were between the ages of 18–30, and if they had ever used or been exposed to any club drugs (e.g. MDMA, GHB, ketamine). The flyers also stated that compensation was available, as well as provided the address and phone number of the research lab. Participants responding to the telephone number were provided information about the study and were invited for an interview in the research laboratories of the Department of Pediatrics. All participants were given US$25 as a stipend for participation. The Institutional Review Board of the participating hospital approved this study and informed consent was obtained from all participants.

2.2. Procedures

The testing session consisted of a semi-structured interview, self-administered questionnaires, and an open-ended interview, which lasted approximately an hour and a half. Participants were informed that interview data were confidential. At the end of the interview, all participants who responded with affirmative answers to alcohol and drug questions were given information about drug and alcohol treatment resources as well as pamphlets explaining their health risks.

2.3. Instruments

2.3.1. The Substance Abuse Interview

Adapted from Streissguth (1986), consists of a series of close-ended, forced choice questions pertaining to timing and frequency of medication, alcohol, and drug use. The interview includes questions regarding date of last use and ends with an interviewer validity code. Data were used to obtain measures of severity and duration of use of MDMA, barbiturates, amphetamines, rohypnol, GHB, ketamine, and other drugs, including cocaine, alcohol, marijuana, and cigarettes. Open-ended questions were also asked to elicit information about respondents' attitudes towards and experiences of drug use. These included descriptions of MDMA experiences, cravings for drugs, queries regarding health outcomes and dangers of drugs, and places and times club drugs were consumed.

2.3.2. The Problem Oriented Screening Instrument for Teenagers (POSIT)

The Problem Oriented Screening Instrument for Teenagers (POSIT) (Rahdert, 1991) is a 139 item, self-administered instrument to screen for adolescent problems in 10 functional areas, substance abuse, physical health, mental health, family relations, peer relations, educational status, vocational status, social skills, leisure/recreation, and aggressive behavior/delinquency. Initial data indicate each problem area was identified as a potential problem in at least 75% of youth in a drug treatment sample. Convergent and discriminant evidence for the POSIT has been reported by an independent research team and the National Institute on Drug Abuse (NIDA) has validated the instrument cut-off scores. The cut-off scores are designed to alert clinicians to the possibility of difficulties in that area, and the need for further evaluation (see Table 3 for cut-off scores). The POSIT was developed by NIDA and has been widely disseminated and used since 1991 (Dembo et al., 1996a,b; Scafidi et al., 1997). Since the POSIT was developed for

teenagers, several questions were modified to accommodate an older sample. For example, instead of referring to parent approval of friends, the modification asked "Do (or did) your parents or guardians approve of your friends?" A majority of the questions were modified to include past tense and content remained unchanged.

2.3.3. The HIV/STD risk scale

The HIV/STD risk scale (Rahdert, 1999) was developed as a supplement to the POSIT to assess the risk for HIV and sexually transmitted diseases (STD's) among adolescents. This 30-item, self-administered questionnaire assesses risky behaviors known to be associated with HIV and STD transmission. The psychometric properties of this scale have not yet been established.

2.3.4. The Childhood Trauma Questionnaire (CTQ)

The Childhood Trauma Questionnaire (CTQ) (Bernstein et al., 1994) consists of 28 questions which yield five scores: physical abuse, emotional abuse, emotional neglect, sexual abuse, and physical neglect. Internal consistency reliability estimates as reported in prior studies using Cronbach's alpha range from 0.66 to 0.92.

2.3.5. The Drug Abuse Screening Test (DAST)

The Drug Abuse Screening Test (DAST) (Skinner, 1982) is a 28 item self-report questionnaire that taps various consequences related to drug misuse combined in a total score to yield a quantitative index of substance related problems. Internal consistency estimates for drug/alcohol abuse clients are 0.92 (Skinner, 1982). The DAST has only moderate correlations with social desirability. Concurrent validity has been demonstrated by correlating total score to background variables, frequency of drug use, and indices of psychopathology. The DAST provided an indirect measure of severity of drug use, and identifies specific functional consequences of drug use for the respondent.

2.3.6. The Brief Symptom Inventory (BSI)

The Brief Symptom Inventory (BSI) (Derogatis, 1992) is a widely used, self-report, 53-item questionnaire which taps a range of psychiatric symptom patterns. It measures somatic complaints, obsessive–compulsive behavior, depression, anxiety, phobic anxiety, paranoid ideation, hostility, and psychoticism, and yields a summary score, the global severity index (GSI), a measure of overall psychological distress. Scores above the 84th percentile are considered moderate clinical problems, whereas scores above the 98th percentile for same sex non-patient norms indicate severe clinical problems.

2.4. Data analyses

To assess group differences between MDMA and non-MDMA users, chi square analyses (Pearson's and Fisher's exact tests) were performed on categorical data, and *t*-tests and the Wilcoxon rank sum tests, as appropriate, for continuous data for demographic and drug characteristics. Several variables were normalized by the natural logarithmic transformation prior to the analysis, including the CTQ variables and one variable on the POSIT (vocational status). Any scale that had a minimum value of zero was increased by one before taking the logarithms. Initially, the POSIT and CTQ outcome variables were analyzed with a MANOVA model to test for an overall effect of MDMA use. A similar analysis was performed for the dichotomized BSI subscales. A generalized estimation equation (GEE) model with an exchangeable covariance structure was constructed to create a global test for MDMA user group. The test is similar to that of MANOVA for continuous data. Although the exchangeable covariance structure may not be the most efficient choice for our data, the GEE model is robust to misspecification of the correlation structure. A logistic regression model was used to test for the effect of MDMA use on the categorized GSI score, while controlling for gender. The level of significance was set at $P < 0.10$ since the study was designed as a pilot study to gather meaningful descriptive data on older adolescent MDMA users. This also allowed for the identification of potentially important trends. Follow-up testing of each individual subscale of the POSIT and CTQ was conducted at a significance level of 0.025 to account for the multiple testing. All analyses of outcome variables controlled for gender since the MDMA sample was predominantly male.

3. Results

3.1. Demographics

Characteristics of the 100 respondents (42 MDMA and 58 non-MDMA users) are reported in Table 1. MDMA users were more likely to be male (74% versus 43%, $P < 0.05$) and had lower academic grade point averages (3.0 versus 3.3, $P < 0.05$) than non-users. On other demographic indices, groups did not differ. Generally, respondents were white (74%), late adolescent age and currently attending college (85%). Based on parental educational level, subjects were middle to upper middle class whose parents had also attended college. The majority of both groups reported that their parents were married.

3.2. Drug use characteristics

MDMA users averaged 9.9 pills over the past year, usually took one pill per occasion, and used less than once per week (Table 1). Table 2 reports other substances used in the past year and the amount used per week. MDMA users were more likely to have used cigarettes (88% versus 64%, $P < 0.05$), but the groups did not differ in their use of alcohol. With the exception of PCP, GHB, and Rohypnol, MDMA users were more likely to have used other drugs, including marijuana,

Table 1
Demographic and MDMA usage of MDMA users and nonusers in sample of older adolescents

	MDMA ($n = 42$)		Non-MDMA ($n = 58$)		t/χ^2	P
	M ± S.D.	n (%)	M ± S.D.	n (%)		
Age	20.8 ± 2	–	20.5 ± 2	–	−0.7	0.46
Grade point average	3.0 ± 0.6	–	3.3 ± 0.5	–	2.3	0.02
Maternal education (years)	15.2 ± 2	–	15.7 ± 3	–	1.0	0.30
Paternal education (years)	16.5 ± 3	–	16.5 ± 3	–	−0.1	0.89
Gender (male)	–	31 (74)	–	25 (43)	9.3	0.01
Ethnicity (white)	–	32 (76)	–	42 (72)	0.2	0.67
Currently in school	–	33 (79)	–	52 (90)	2.3	0.13
Maternal marital status (% married)	–	31 (74)	–	41 (72)	0.04	0.84
Paternal marital status (% married)	–	30 (79)	–	40 (70)	0.9	0.34
MDMA usage						
Number of pills (lifetime)	9.9 ± 17	–	0	–	–	–
Number per occasion	1.0 ± 0.9	–	0	–	–	–
Days per week	0.4 ± 0.4	–	0	–	–	–
Money spent per pill (US$)	16 ± 10	–	0	–	–	–
Money spent per month (US$)	21 ± 22	–	0	–	–	–

cocaine, amphetamines, barbiturates, benzodiazepines, heroin, LSD, hash, ketamine (P values 0.05), and were more likely to have been prescribed antidepressants (17% versus 5%, $P = 0.05$) and Ritalin (23% versus 4%, $P < 0.01$). For the MDMA group, the amount of marijuana dose per week was significantly higher than for non-users (11.4 versus 2.7, $P < 0.0001$), as well as the number of cigarettes consumed per day (9.8 versus 3.0, $P < 0.001$). MDMA users did not differ from non-MDMA users in the amount per week used of cocaine or alcohol. Further, the TWEAK score, a screening measure of alcohol dependency and a self-report of problems with alcohol, did not differ between groups.

Table 2
Other drug use of older adolescent sample of MDMA users and nonusers

	MDMA ($n = 42$) n (%)	Non-MDMA ($n = 58$) n (%)	χ^2/t	P
Use of substance in past year				
Cigarettes	37 (88)	37 (64)	7.5	0.01
Alcohol	41 (98)	55 (95)	0.5	0.64
Marijuana	42 (100)	38(66)	18.1	0.0001
Cocaine	13 (31)	1 (2)	17.0	0.0001
Amphetamines	19 (45)	3(5)	22.8	0.0001
Barbiturates	19 (45)	8 (14)	12.2	0.0005
Benzodiazepines	8 (19)	0 (0)	12.0	0.0006
Heroin	3 (7)	0 (0)	4.3	0.07
LSD/acid[a]	33 (79)	12 (21)	33.0	0.0001
Hashish	19 (45)	12 (21)	6.9	0.01
GHB[b]	4 (10)	1 (2)	3.1	0.15
Rohypnol	2 (5)	1 (2)	0.8	0.57
Ketamine	16 (38)	1 (2)	22.8	0.0001
Antidepressants[c]	7 (17)	3 (5)	3.7	0.05
Ritalin[c]	9 (23)	2 (4)	8.6	0.007
Amount used in past year[d]	M ± S.D.	M ± S.D.	z	P
Alcohol dose per week	13.5 ± 11	9.7 ± 10	2.4	0.01
Cigarettes per day	9.8 ± 10	3 ± 6	4.6	<0.0001
Marijuana dose per week	11.4 ± 14	2.7 ± 6	5.4	<0.0001
Cocaine dose per week	0.03 ± 0.1	0	1.4	0.09
TWEAK score	13.2 ± 6	12.0 ± 8	−0.9	0.40

[a] Lysergic acid diethylamide.
[b] Gamma-hydroxybutyrate.
[c] Prescribed by doctor.
[d] Analyses using nonparametric Wilcoxin rank sum.

Table 3
POSIT and HIV/STD scale scores in MDMA users and nonusers

POSIT scale (cut-off scores)	MDMA ($n = 42$) M ± S.D.	Non-MDMA ($n = 58$) M ± S.D.	F	P[a]
Substance use (1)	5.3 ± 3	3.7 ± 3	2.1	0.15
Physical health (3)	3.4 ± 2	2.6 ± 2	3.9	0.05
Mental health (4)	6.8 ± 4	5.5 ± 4	1.6	0.21
Family relations (4)	3.9 ± 2	2.6 ± 2	9.5	0.003
Peer relations (1)	4.9 ± 2	3.5 ± 2	4.1	0.04
Educational status (6)	8.1 ± 4	6.2 ± 4	4.0	0.05
Vocational status[b] (5)	2.5 ± 2	1.3 ± 1	7.6	0.007
Social skills (3)	3.1 ± 2	2.1 ± 2	4.8	0.03
Leisure/recreation (5)	4.8 ± 2	3.4 ± 2	8.9	0.004
Aggressive behavior and delinquency (6)	6.3 ± 3	5.6 ± 3	0.01	0.91
	n (%)	n (%)	χ^2	P
HIV/STD risk				
Total score	12 ± 3	8.9 ± 4	13.6	0.001

[a] P values adjusted for gender.
[b] Analysis using the log value.

3.3. Problem Oriented Screening Instrument for Teenagers (POSIT)

MDMA users were significantly different from non-MDMA users on a number of dimensions of the POSIT (See Table 3). The global test for an overall effect of MDMA use was significant ($F = 2.4$, $P < 0.05$). MDMA users experienced greater difficulties with family relationships (3.9 versus 2.6, $P < 0.05$) and peer relationships (4.9 versus 3.5, $P < 0.05$), and felt that they had fewer vocational assets (2.5 versus 1.3, $P < 0.05$). They also described themselves as having more difficulty in social situations (3.1 versus 2.1, $P < 0.05$) and felt less able to structure their leisure and recreational time (4.8 versus 3.4, $P < 0.01$). There were no differences in problems associated with physical health, substance use, educational status, mental health, or aggressive/delinquent behaviors. When normative data from the POSIT were considered, the mean scores of both MDMA users and non-MDMA users fell above the cut-off scores for substance use, mental health, peer relationship, and educational status problems, indicating the high risk level of both groups. Only the MDMA group fell above the cut-off for risk in the physical health, aggressive and delinquent behavior, and social skills categories.

3.4. HIV/STD risk scale

MDMA users reported engaging more in behaviors that placed them at risk for HIV and other sexually transmitted diseases, such as not using protection during sex, having multiple partners, and using intravenous drugs (Table 3). MDMA users had a total risk score of 12.0 as compared to non-MDMA users mean of 8.9 ($P < 0.01$).

Table 4
Childhood Trauma Questionnaire results in MDMA users and nonusers

	MDMA ($n = 42$) M ± S.D.	Non-MDMA ($n = 58$) M ± S.D.	F	P[a]
Total trauma score	46.5 ± 11	42.1 ± 5	7.5	0.01
Emotional abuse[b]	8.3 ± 4	7.6 ± 4	2.0	0.16
Physical abuse[b]	7.2 ± 3	5.8 ± 1	7.5	0.007
Sexual abuse[b]	5.4 ± 2	5.3 ± 1	0.6	0.44
Emotional neglect[b]	9.5 ± 4	7.8 ± 3	5.4	0.02
Physical neglect[b]	6.8 ± 3	5.5 ± 1	9.9	0.002

[a] P values adjusted for gender.
[b] Tests based on log values.

3.5. Childhood Trauma Questionnaire (CTQ)

MDMA users had significantly higher total trauma scores than non-users (46.5 versus 42.1, $P < 0.05$). A MANOVA was conducted with the subscales of the CTQ, controlling for gender, and a global effect of MDMA use was found ($F = 2.7$, $P < 0.05$). These scores reflected more self-reported experiences of physical abuse (7.2 versus 5.8, $P < 0.01$), and of emotional and physical neglect (P values <0.05) during childhood (see Table 4). The experience of physical abuse includes items such as being hospitalized after being hit, or being punished with a belt or other hard object. MDMA users classified themselves as more emotionally neglected by not endorsing items such as "I felt loved", and they remembered more episodes of physical neglect by endorsing items describing their parents as being "too intoxicated to take care of the family," and "feeling as if there was no one to take care and protect them."

3.6. Drug Abuse Screening Test (DAST)

On the DAST, MDMA users described themselves as having more severe drug use related symptoms than non-MDMA users (6.8 versus 3.3, $P < 0.0001$). These symptoms include more endorsements of: blackouts/flashbacks, abusing more than one drug, and engaging in illegal activities to obtain drugs.

3.7. Brief Symptom Inventory (BSI)

When groups were compared (Table 5) based on those experiencing clinically relevant symptoms, a non-significant global effect of MDMA use was found ($\chi^2 = 9.9$, d.f. $= 8$, $P < 0.30$). Due to the pilot nature of the study, we performed follow-up testing on each subscale. MDMA users were significantly more likely to have symptoms in the clinically moderate range for depression (41% versus 19%, $P < 0.025$), controlling for gender. The groups were not significantly different on any other subscale when dichotomized at the clinically moderate cut-off range. The groups were different on the global severity index at the moderate clinical range (36% versus 17%, $P < 0.10$). Further analysis of the

Table 5
Psychological distress measures from the BSI in MDMA users and nonusers

	MDMA ($n = 42$) n (%)	Non-MDMA ($n = 58$) n (%)	χ^2	P^a
Moderate (>84th percentile)				
Somatic complaints	12 (29)	7 (12)	2.8	0.10
Obsessive–compulsive	22 (52)	14 (24)	6.2	0.01
Depression	17 (41)	11 (19)	3.9	0.05
Anxiety	14 (33)	8 (14)	3.7	0.05
Hostility	10 (24)	5 (9)	2.8	0.10
Phobic anxiety	10 (24)	10 (17)	0.3	0.56
Paranoid ideation	11 (27)	11 (19)	0.4	0.53
Psychoticism	20 (48)	15 (26)	3.6	0.06
Global severity index	15 (36)	10 (17)	3.5	0.06
Severe (>98th percentile)				
Somatic complaints	3 (7)	1 (2)	1.0	0.31
Obsessive compulsive	8 (19)	2 (4)	3.9	0.05
Depression	4 (10)	4 (7)	0.2	0.99
Anxiety	4 (10)	1 (2)	1.8	0.18
Hostility	1 (2)	2 (3)	0.3	0.58
Phobic anxiety	1 (2)	5 (9)	2.8	0.10
Paranoid ideation	3 (7)	4 (7)	0.1	0.81
Psychoticism	10 (24)	4 (7)	2.7	0.10
Global severity index	7 (17)	4 (7)	1.0	0.31

[a] P values adjusted for gender.

BSI scales dichotomizing at the severe clinical range yielded a significant global effect for MDMA use ($\chi^2 = 14.5$, d.f. $= 8$, $P < 0.10$), however none of the subscales were significantly different between the groups at the adjusted level of 0.025. A trend was observed for obsessive–compulsive symptoms, in that MDMA users were significantly more likely to be classified in the severe range (19% versus 4%, $P < 0.05$).

4. Discussion

The present survey documented drug using habits, functional lifestyle, and personality characteristics of older adolescent users of MDMA in the United States in comparison to non-MDMA users. Similar to reports on users in European countries, MDMA users were polydrug users who primarily used MDMA on an occasional basis for recreational purposes (see Parrott, 2001). MDMA users were much more likely to use multiple substances than non-MDMA users, and similar to European studies, were more extensive users of stimulants and hallucinogens (Parrott et al., 2001). Although both users and non-users were equally likely to use alcohol, all MDMA users were regular marijuana users, and there was high use of other drugs such as cocaine, LSD, ketamine, amphetamines, and barbiturates.

MDMA users reported experiencing more functional problems in daily living than did the comparison group, even though the comparison group was a high risk group in comparison to normative adolescent standards. Their academic grades were significantly lower and they identified more problems in family, social, peer, and recreational areas of their lives. The greater incidence of functional problems contradicts the widely disseminated image of MDMA as a benign drug promoting emotional warmth and empathy (Koesters et al., 2002) and is consistent with frequently reported occupational, relationship, and financial problems in an Australian sample which could not be predicted by the use of other drugs (Topp et al., 1999).

Of major concern is the accelerated risk for HIV and other sexually transmitted diseases based on the reported sexual activity and practices of the MDMA users. This STD risk is consistent with other research showing risky sexual behavior among gay and bisexual men, after controlling for other drug use (Klitzman et al., 2000). Also, venues typical of MDMA use, primarily dance clubs and parties, combined with the drug's accentuation of feelings of social empathy and heightened tactile sensitivity may promote more promiscuous and risky sexual behavior (Parrott and Lasky, 1998; Brown, 2002).

MDMA users also self-reported more experiences of childhood trauma compared to non-MDMA users. It may be that these symptoms predated MDMA usage and were a factor in precipitating poly-substance use. Alternatively, it may be that MDMA users had more chaotic, substance using caregivers, thus predisposing them to later substance use as reported in other adolescent studies (Merikangas et al., 1992). Further research on the factors affecting initiation of MDMA use should be evaluated in other populations.

Despite the non-clinical nature of the sample, MDMA users endorsed experiencing more symptoms of psychological distress than non-users, with more than a third falling in the range indicating clinically relevant symptoms. The most prominent specific problems were obsessive–compulsive symptoms and psychoticism, difficulties reported by more than half of the MDMA users. These findings are consistent with other international studies using a longer version of the measure used in this study (Parrott et al., 2000, 2001; Schifano, 2000). Further, the MDMA users reported significantly more symptoms of depression compared to non-MDMA users. Other studies (Curran and Travill, 1997; Parrott and Lasky, 1998; McGuire et al., 1994) have found depressive symptoms related to use of MDMA, consistent with the hypothesis that serotonin functioning may be affected by MDMA use. MDMA users were also more likely to report taking antidepressants than non-users, lending further support for the salience of these symptoms. The prominence of obsessive–compulsive symptoms, psychoticism, and depression is consistent with findings from laboratory studies suggesting that these disorders may be caused by deficiencies within the serotonin systems in the brain (Naughton et al., 2000). The clinically notable symptoms reported by the MDMA users may also reflect the drug's neurotoxic mechanisms, which are thought to be the results of its effects on the release of serotonin through a decrease in serotonin transporters (National Institute on Drug Abuse,

2002) leading long term to lower levels of serotonin and its metabolites in spinal fluid (Ricaurte et al., 2000b; Ricaurte et al., 1988).

The life problems identified in this sample may be secondary to chronic personality, cognitive, and motivational difficulties often found in habitual substance users since the MDMA users in this sample were also heavier users of marijuana than the controls, and liberally used other substances with major psychopharmacologic effects, such as LSD, cocaine, and barbiturates. Preexisting deficits in social skills may have led to alcohol and drug use as a means of coping with social anxiety as has been postulated in some theoretical models (Glantz and Pickens, 1992; Merikangas et al., 1992). Although more MDMA users were prescribed antidepressant medication and/or stimulants for attention deficit disorders, our data collection did not enable us to discern whether the problems treated were prior to or subsequent to MDMA use (Anteghini et al., 2001).

Several limitations of this study should be considered. Sampling issues may limit the generalizability of this study. This convenience sample was primarily white, of middle-class, college students, and thus may not be representative of the majority of MDMA users. Nonetheless, the fact that our findings are reasonably consistent with those in the literature suggests that this sample may be similar to other sampled populations of MDMA users. Second, because MDMA users in this sample were also heavier users of marijuana and other drugs known to influence sexual activity, the influence of other drugs on personality and behavior in the MDMA users should also be considered. Finally, retrospective reports of drug use may be problematic, particularly with MDMA and marijuana users with these drugs shown to affect memory abilities (Parrott, 2001; Bolla et al., 1998; Gouzoulis-Mayfrank et al., 2000; Verkes et al., 2001).

A pilot survey of MDMA and non-MDMA users was used in the present study to examine the psychosocial consequences of drug use. On most indices examined in this study, MDMA users experienced more negative psychosocial difficulties as compared to controls. Continued efforts to assess the personality and childhood experiences of MDMA and polydrug users are essential to determine effective interventions with this population.

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