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The varieties of ecstatic experience: an exploration of the subjective experiences of ecstasy

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Abstract

Previous investigations of the subjective effects of MDMA (material sold as ecstasy) have conducted interviews and surveys of various groups of ecstasy users within particular sub-populations. This study examined subjective drug effects reported by different sub-populations of ecstasy users and explored whether the function or purpose served by using ecstasy influenced the nature of the drug experience. Drawing on previous measures of alterations in consciousness, psychedelic drugs and cannabis, and informal interviews with ecstasy users and MDMA researchers, a 130-item survey assessing subjective effects of ecstasy/MDMA was developed. Principal components analysis of responses of ecstasy users revealed six components; perceptual alterations, entactogenic effects, prosocial effects, aesthetic effects, negative effects and sexual effects. The derived scale was used to predict ecstasy use behaviours, and functions and experiences of use. A variety of component scores were related to ecstasy use parameters; in particular, heavier users expected fewer negative, perceptual and aesthetic effects from taking the drug. The reasons given for using ecstasy (use function) also influenced reported drug effects. Abstainers expected greater negative, perceptual, aesthetic and sexual effects than users. These data indicate that the subjective ecstasy experience is influenced by a variety of extra-psychopharmacological factors. Drug intervention strategies may be made more effective by targeting particular user groups defined by reasons given for substance use, as it is likely that their experiences of ecstasy effects will differ. Future research into ecstasy may be improved by recognizing user diversity.

Keywords

ecstasy, MDMA, entactogens, drug effect expectancies, inventory

Introduction

The entactogen, (±) 3,4-Methylenedioxymethamphetamine (MDMA) is more commonly known as the street drug ecstasy, although because of legal proscription the two are not necessarily identical (Cole *et al.*, 2002b). Current monitoring systems indicate that in the UK, approximately 5% of 16–29 year olds have reported having tried ecstasy at least once, and figures are similar across Europe and the USA (Johnston *et al.*, 2002; von Sydow *et al.*, 2002; Aust *et al.*, 2003; Condon and Smith, 2003). Reviewing the literature and assessing the findings of informal interviews, we have identified several main groups of contemporary ecstasy user, differentiated by their preferred setting of use. These groups include attendees at dance music clubs (Forsyth, 1996); attendees at house parties and other social gatherings (Hansen *et al.*, 2001; Williams and Parker, 2001); people favouring use among small groups of friends (e.g. McDermott, 1993) or with a sexual partner (e.g. Zemishlany *et al.*, 2001); and people who take ecstasy as part of a self-defined personal developmental practice (Stolaroff, 1997). Prior to its scheduling, MDMA was used by some psychotherapists in the US (Greer and Tolbert, 1998; Metzner and Adamson, 2001), and even now some individuals use ecstasy in a psychotherapeutic context, alone or assisted by therapists working clandestinely (see for example Stevens, 1997, 1999, 2000; Holland, 2001), and initial work has begun on MDMA-assisted psychotherapy in people with posttraumatic stress disorder (PTSD) (Mithoefer, 2003). The wide range of use locations outside the nightclub is supported by a recent contextual profile of 'club drug' use in the USA (Fendrich *et al.*, 2003).

MDMA possesses a complex pharmacology involving most of the major neurotransmitter and neurohormonal systems (Liechti and Vollenweider, 2001; Cole and Sumnall, 2003b; Green *et al.*, 2003). Human volunteers receiving MDMA in controlled settings report that MDMA produces euphoria, dysphoria, slight alterations in perception, perceived physiological effects and side effects, such as tight jaw, reduced appetite and difficulty concen-

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trating (Cami *et al.*, 2000; Liechti *et al.*, 2001b; Harris *et al.*, 2002; Tancer and Johanson, 2003). However, the instruments used in these studies may not be suitable for assessing all of the acute effects of MDMA. For instance, items designed to measure increased feelings of intimacy, trust, closeness to others or empathy, all effects that users have ascribed to the drug (Siegel, 1986; Peroutka *et al.*, 1988; Liester *et al.*, 1992; Solowij *et al.*, 1992), are either minimally represented or missing from these scales entirely. Subjective and somatic effects reported in retrospective studies of ecstasy effects are largely comparable to those reported in controlled settings (Siegel, 1986; Peroutka *et al.*, 1988; Solowij *et al.*, 1992; Cohen, 1995; Davison and Parrott, 1997). These studies have tended towards inclusion of simple, non-specific inventory items and so may not reflect the wide, complex subjective and physical phenomenology reported by subjects during clinical MDMA administration, perhaps as a result of relying upon instruments used for measuring mood states (Davison and Parrott, 1997; Parrott and Stuart, 1997) or generalized inventories of drug effects (Cohen, 1995; Curran and Travill, 1997). Recently, a more detailed study by Verheyden and colleagues (2003) identified three general factors underlying self-reported subjective experience in recreational ecstasy users; positive, negative and physical effects. However, as patterns of polysubstance use were also related to factor scores, it was uncertain whether the factorial structure was specific to ecstasy, to wider experiences of drug use or to pre-existing factors leading to polysubstance use, including use of ecstasy. Researchers might be better equipped to study the acute effects of MDMA through using a measure specifically tailored to assess the effects of MDMA. The existence of such a measure may help investigators studying the effects of ecstasy or MDMA in a variety of settings.

Drug effects may depend upon the social and environmental context in which the substance is administered (Fraioli *et al.*, 1999; Vogel-Sprott and Fillmore, 1999). Social pharmacological principles (broadly defined as how the perceived effects and consequences of drug use are socially and culturally organized (Rhodes, 1996)), suggest that naturalistic investigations of drug-induced behaviours should also consider social understandings of intoxication, and culturally-specific expectations of drug ingestion (e.g. whereas in Western society alcohol is expected to produce behavioural disinhibition, in many other cultures such behaviour is unknown (MacAndrew and Edgerton, 1969)). The wide variety of social settings in which ecstasy is consumed (Fendrich *et al.*, 2003; Hansen *et al.*, 2001) raises the possibility that different user groups may report disparate drug effects.

Understanding reasons underlying substance choice enables the provision of information targeted towards specific groups, which may persuade them to reconsider their substance use behaviours (Boys and Marsden, 2003). Work by Boys and colleagues proposes that it is largely the perceived function served by using a specific substance that drives drug use behaviour (Boys *et al.*, 1999; Boys and Marsden, 2003), and according to the cost/benefit model of substance use (Parker *et al.*, 1998), there is an association between perceived long-term benefits and lifetime ecstasy use (Gamma *et al.*, 2005). Whilst prosocial and mood-enhancing effects are most prominent among the perceived functions of substance use in general, ecstasy has been reported to be particularly useful for recreational users as a means to prolong socializing during a night out with friends, to produce physical activation and 'energizing', and to enhance feelings of elation or euphoria (Boys *et al.*, 2001). Psychiatrists who self-administered MDMA were more liable to note decreased defensiveness and decreased sense of separation or alienation from others in their reports (Liester *et al.*, 1992), and people seeking self-knowledge or spiritual growth through MDMA or ecstasy use have often reported, and intentionally preferred, insight-related effects over euphoria (Watson and Beck, 1991). These differences extend to the perception of negative effects, with psychiatrists more likely to report undesirable mental or emotional effects (Liester *et al.*, 1992), and university students and dance event attendees more focused on somatic complaints by comparison (Curran and Travill, 1997; Peroutka *et al.*, 1988), which may be the result of extended periods of dancing. This suggests that motivation for use, i.e. why an individual chooses to use a drug, may contribute to the type of effects reported.

This exploratory study investigated the relationship between intentions for ecstasy use, patterns of ingestion and acute subjective experiences in a variety of different types of ecstasy users. It was hypothesized that ecstasy effects would be partially dependent upon the social context in which the drug was used, and that subjective reports would differ between types of user group depending upon self-reported functions/intention of use. Accordingly, it was also hypothesized that user group classification, according to use function, would predict drug preference and drug use patterns. It was anticipated that the data obtained would facilitate construction of a short scale assessing ecstasy effects and effect expectations (hereto referred to as E-EXP), which could be developed with further work for use in studies of harm reduction and/or drug information strategies.

Methods

Subjects

Three hundred and five unpaid volunteers (268 ecstasy users, 37 abstainers) were recruited by means of printed posters placed around University campus, Liverpool city centre, and in local record shops, advertisements hosted on Internet sites containing information about ecstasy, email forums, articles in regional magazines, the snowball technique and the key informant access method in Liverpool (UK) and Boston (US). The advertising strategy was designed to increase the chances of obtaining a heterogeneous sample in terms of reasons underlying ecstasy use. The majority of study respondents resided in North America ($n = 143$), followed by the UK ($n = 83$); the remaining were mainly drawn from Australia and Eire. The study was advertised as an investigation of the effects of ecstasy and was open to both users and abstainers. All potential volunteers were provided with detailed information about the study and were assured that their responses would remain confidential. In total 323 completed the study although 18 (5.6%) were excluded after spoiling the questionnaire

or providing intentionally misleading answers (e.g. an 18 year old university professor, a young individual with a self reported history of 10 000 ecstasy tablets). The ethics committee at the University of Liverpool gave their approval for this research study and all subjects were required to give informed consent after receiving a description of the investigation.

Questionnaire design

Volunteers were required to complete a single questionnaire consisting of two sections. The first section requested demographic information and a detailed history of use of a wide variety of substances. Our previous research in this area has indicated that volunteers have great difficulty recalling lifetime use of alcohol, cannabis and cigarettes (Sumnall *et al.*, 2004), hence current patterns of use of these substances were also assessed by requesting additional information about consumption over the previous 7 days and previous month. To test the hypothesis that use function may affect subjective experience, participants were required to select from among a list of statements the reason or reasons for their use of ecstasy (e.g. 'I use ecstasy to explore altered states of consciousness' (ASC); 'I use ecstasy for raving/clubbing') and to rank them in order of preference, thereby allowing determination of a primary use function. Items included in the list were derived from the literature and informal interviews with an independent sample of ecstasy users.

In the second section of the questionnaire, volunteers were presented with a list of 130 statements about the effects of a 'moderate' amount of MDMA/ecstasy. Items were generated from earlier informal interviews with ecstasy users, personal communications from MDMA researchers, and adapted from literature describing the acute and immediate clinical and recreational effects of entactogens (e.g. Peroutka *et al.*, 1988; Hermle *et al.*, 1993; Liechti *et al.*, 2001a). Items were also adapted from the marijuana and cocaine effect expectancy scales (Schafer and Brown, 1991), Tart's marijuana inventory (Tart, 1977), and the Psychedelic Experience Questionnaire (Pahnke and Richards, 1966). A wide variety and large total number of items were chosen because of the exploratory nature of the study, and the paucity of literature on the effects of ecstasy intoxication outside of laboratory settings. Included items were selected by consensual agreement between the research team, and post-doctoral psychologists familiar with the reported subjective effects of ecstasy. Participants were asked to indicate how often they experienced each particular effect or event listed after taking ecstasy by selecting a number along a five-point Likert scale. Respondents were requested to respond as if ecstasy was always MDMA. If they had not experienced the effect described by an item, they were asked to decide, based upon their understanding of the drug's effects, how often they believed the effect occurred in others who had taken ecstasy. Abstainers were required to respond in the same manner as ecstasy users who had not experienced a specific drug effect, by asking them to indicate their beliefs concerning the frequency of occurrence of the effect in ecstasy users. Having ecstasy users and abstainers complete the questionnaire in a similar manner allowed for the assessment of drug effect expectancies. In this way drug effect expectations and experiences could be distinguished. All subjects were asked to respond according to their own standards for dose (i.e. their definition of 'moderate') and setting (e.g. location of use).

Statistical analyses

Preliminary data screening reduced the number of scale variables included in subsequent analyses. Briefly, items with limited range (i.e. all points on scale not used) and/or with high/low standard deviation were removed. Other items that were removed included those yielding significant skewness and kurtosis distribution scores, items not significantly correlating at 1% or 5% significance levels, and items correlating too highly with many other items, removed to avoid multicollinearity. The remaining variables were entered into a principal components analysis (PCA) with Scree plot criterion to determine the number of components to be entered into oblique direct oblimin rotation. Before final analysis of the extracted components, the anti-image matrix was examined to enable removal of partially correlated items.

Factor based scale scores were generated for all volunteers (i.e. both ecstasy experienced and ecstasy naive individuals), and subscales were explored as a function of use intention, patterns of drug use and demographics using a variety of statistical techniques. Correlational analyses were used to assess relationships between component scores and demographic variables, and relationships between component scores and drug use parameters. A modified Bonferroni correction was used to correct for multiple comparisons (Jaccard and Wan, 1996). Regression analyses and logistic analyses were used to test predictive models of relationships between one or more E-EXP component score and respondents' drug use parameters, and the most frequently listed functions of ecstasy use. The Mann-Whitney U test was used to compare component scores of ecstasy users with those of abstainers. Possible relationships between reported functions of ecstasy use and usual locations of use were examined via chi-square analyses. SPSS v11.0 was used for all analysis; significance was set at $p < 0.05$.

Results

Sample characteristics

Ecstasy users ($n = 268$) consisted of 169 (63.1%) males and 99 (37.0%) females, with a mean age of 26.2 ± 0.48 years (range 18–72). One hundred and twenty nine (48.1%) had attained at least a University degree. Five individuals (1.9%) were unemployed, 98 (36.6%) were engaged in education and the remaining 165 (61.6%) were either employed, retired or homemakers. Abstainers ($n = 37$) consisted of 11 (30.0%) males and 26 females (70.0%) with a mean age of 27.6 ± 8.7 (range 18–51). Sixteen (45.7%) had attained at least a University degree. One (2.9%) was unemployed, eight were pursuing education (22.3%), and the remaining 26 (74.3%) were either employed, retired or homemakers.

Substance use parameters for ecstasy users and abstainers are displayed in Table 1. There were consistent associations among

Table 1 Self reported polysubstance use

		% Subjects reporting use ($n = 268/37$)	Estimated lifetime exposure (or units/week)		Duration of use (months)		Use per episode[2]		Days used/month in previous year	
			Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	Range
Alcohol	*User*	97.8	13.1 ± 23.9	0–50	119.0 ± 59.2	0–480	9.6 ± 6.3	0–20	10.8 ± 19.9	0–30
	Abstainer	91.9	12.1 ± 12.4	0–50	136.0 ± 98.1	11–360	7.1 ± 6.3	0–35	13.7 ± 15.6	0–30
Amphetamine	*User*	62.7	27.0 ± 110.0	0–1000	16.6 ± 39.5	0–400	1.2 ± 6.6	0–7	1.28 ± 3.9	0–31
	Abstainer	10.8	4.3 ± 25.0	0–150	2.9 ± 15.8	0–96	0.0 ± 0.2	0–1	–	–
Cannabis	*User*	96.3	11.3 ± 24.4	0–70	83.1 ± 32.8	0–500	6.5 ± 7.5	0–30	17.9 ± 15.6	0–365
	Abstainer	81.1	0.9 ± 2.4	0–12	38.4 ± 50.7	0–240	1.3 ± 1.9	0–8	3.3 ± 6.6	0–28
Cigarettes	*User*	83.5	35.9 ± 56.4	0–280	74.4 ± 42.4	0–240	7.9 ± 2.3	0–30	15.2 ± 3.8	0–30
	Abstainer	70.3	14.8 ± 40.5	0–175	42.6 ± 58.8	0–240	3.1 ± 6.2	0–25	6.4 ± 11.7	0–30
Cocaine HCl	*User*	66.4	15.2 ± 51.0	0–500	18.0 ± 46.2	0–360	0.6 ± 3.3	0–10	0.9 ± 3.6	0–30
	Abstainer	16.2	9.5 ± 50.0	0–300	3.1 ± 11.1	0–60	0.1 ± 0.4	0–2	0.3 ± 1.3	0–8
Crack cocaine	*User*	11.6	5.37 ± 62.0	0–1000	1.0 ± 5.4	0–48	0.18 ± 1.5	0–15	0.06 ± 6.4	0–10
	Abstainer	0.0	–	–	–	–	–	–	0	0
Ecstasy	*User*	100.0	107.6 ± 262.2	1–3000	44.6 ± 21.3	1–325	2.3 ± 3.9	1–10	2.1 ± 3.5	0–15
	Abstainer	0.0	–	–	–	–	–	–	–	–
GHB	*User*	21.6	10.8 ± 54.9	0–500	3.3 ± 10.5	0–72	0.3 ± 0.8	0–4	0.4 ± 2.3	0–10
	Abstainer	2.7	0.1 ± 0.8	0–5	0.0 ± 0.2	0–1	0.0 ± 0.2	0–1	–	–
Mushrooms[3]	*User*	69.4	45.5 ± 15.2	0–10000	30.1 ± 58.7	0–400	8.9 ± 64.0	0–1000	0.5 ± 1.1	0–10
	Abstainer	27.0	8.6 ± 26.4	0–150	5.3 ± 16.0	0–72	0.5 ± 1.4	0–5	0.1 ± 0.7	1–4
Herbal/Plant material[4]	*User*	35.1	2.3 ± 10.3	0–100	3.5 ± 14.3	0–120	0.1 ± 0.5	0–7	0.4 ± 1.9	0–20
	Abstainer	13.5	–	–	0.8 ± 0.4	0–2	–	–	0.1 ± 0.4	0–2
Heroin	*User*	16.4	1.7 ± 13.1	0–200	2.9 ± 22.1	0–240	0.7 ± 9.3	0–150	0.1 ± 1.9	0–3
	Abstainer	0.0	–	–	–	–	–	–	–	–
Ketamine	*User*	35.4	4.5 ± 20.1	0–250	5.7 ± 14.1	0–112	0.67 ± 6.4	0–10	0.4 ± 1.8	0–15
	Abstainer	0.0	–	–	–	–	–	–	–	–
LSD	*User*	63.4	49.2 ± 159.2	0–1600	37.2 ± 71.4	0–400	1.8 ± 5.4	0–15	0.4 ± 2.0	0–30
	Abstainer	18.9	2.0 ± 6.1	0–30	7.8 ± 24.0	0–120	0.2 ± 0.6	0–2	–	–
Nitrate 'Poppers'	*User*	41.8	34.7 ± 192.3	0–2500	7.3 ± 20.8	0–168	1.1 ± 6.5	0–100	0.2 ± 0.9	0–10
	Abstainer	24.3	25.1 ± 133.1	0–800	9.3 ± 40.5	0–240	1.4 ± 6.6	0–40	0.1 ± 0.3	0–2
'Tranquillizers'	*User*	38.1	68.2 ± 625.3	0–10000	9.9 ± 38.1	0–336	1.1 ± 6.3	0–50	0.8 ± 3.4	0–30
	Abstainer	10.8	6.2 ± 33.4	0–200	0.2 ± 1.0	0–6	–	–	–	–
Viagra	*User*	10.1	0.9 ± 6.8	0–100	0.8 ± 4.5	0–48	0.1 ± 0.7	0–10	0.1 ± 0.8	0–10
	Abstainer	2.7	0.2 ± 1.0	0–6	0.3 ± 2.0	0–12	–	–	0.1 ± 0.3	0–2

Only most frequently reported substances are reported here (>10% sample). Figures are shown for ecstasy users (top data) and abstainers (lower data). Refer to results section for details of other substance use.

[1]Subjects were asked to answer with regards to a 'typical' use episode.

[2]Standardized units (e.g. tablets, 'wraps'). Regarding alcohol, respondents referred to (e.g.) a 'night out' rather than (e.g.) 'mid-week' glass of wine, hence the mean is high.

[3]includes hallucinogenic genera of different potency, hence use parameters may be misleading.

[4]E.g. salvia divinorum, peyote, ayahuasca; – missing data/NA.

Table 2 Ecstasy use parameters ($n = 268$)

	Lifetime use	Days used/month	Use per episode	Abstention (weeks)	Duration of use (months)
Lifetime	–	0.34**	0.39**	−0.13*	0.54**
Days/month	0.34**	–	0.54**	−0.47**	0.06
Use/episode	0.39**	0.54**	–	−0.27**	0.14*
Abstention (weeks)	−0.13*	−0.47**	−0.27	–	−0.03
Duration (months)	0.54**	0.06	0.14*	−0.03	–

Shown are Spearman correlation coefficients. *$p < 0.05$; **$p < 0.01$.

various parameters of ecstasy use, with more experienced users (in terms of estimated lifetime consumption), using the drug more recently and frequently, in greater quantities per episode, and for longer periods of time (Table 2). Lifetime use of ecstasy was also significantly correlated with estimated consumption of other drugs including alcohol, cannabis, cocaine and LSD (Table 3), with heavy use of ecstasy generally associated with heavy use of all substances (Table 4). Associations between use of one substance and use of others was similar to associations reported in a sample of dance event attendees (Sumnall *et al.*, 2004).

Of those individuals specifying usual location of ecstasy use ($n = 262$), 110 (41.0%) reported usually ingesting the drug at entertainment venues (e.g. bar, club/rave, music concert). One hundred and thirty nine (51.9%) respondents reported usually taking ecstasy in private houses (own home, $n = 98$ (35.6%); friend's home, $n = 41$ (15.3%)). Thirteen (4.9%) respondents reported usually taking ecstasy outside. These groups did not differ in terms of ecstasy use parameters.

Principal components analysis

Items were removed if loadings were less than 0.40 on primary components or greater than 0.40 on a secondary component (Field, 2000). Rotation retained six components (31 items) accounting for 60.2% of total item variance (Table 5). *Perceptual Alterations* consisted of five items; the second component, *Entactogenesis*, consisted of four items; the third component, *Prosocial Effects*, consisted of four items; the fourth component *Aesthetic and Mood Effects*, consisted of six items; the fifth component, *Negative Intoxication Effects*, consisted of seven items; and the sixth component, *Sexual Effects*, consisted of five items. Overall, the Cronbach alpha coefficient was 0.81; individual item coefficients were good and ranged from 0.80 to 0.82. Internal component coefficient alphas were acceptable and ranged from 0.62 to 0.70.

Examining country of residence, t-tests showed that there was no difference in component score between people residing in North America ($n = 143$) and the UK ($n = 83$) (the two main places of residence for respondents).

The mean proportion of endorsed items (i.e. reporting ever experienced an item) for each component was correlated (Spearman's) against total component score. All correlations were positively significant, indicating that component scores closely reflected experiences rather than expectations (Perceptual Alterations, $r = 0.745$; Entactogenesis, $r = 0.625$; Prosocial Effects, $r = 0.406$; Aesthetic and mood effects, $r = 0.706$; Negative Intoxication, $r = 0.693$; Sexual Effects, $r = 0.581$; all $p < 0.001$).

Ecstasy use history was compared for E-EXP components using Mann Whitney U-Test in order to examine the differences between subjective experiences (users) and expectations (abstainers). Ecstasy abstainers scored significantly higher than experienced individuals on perceptual alterations ($\mu = 17.92 \pm 2.36$ vs. $\mu = 14.14 \pm 3.99$; $U = 2103.0$, $p < 0.001$), aesthetic and mood effects ($\mu = 21.17 \pm 2.57$ vs. $\mu = 18.45 \pm 4.22$; $U = 2772.0$, $p < 0.001$), negative intoxication effects ($\mu = 22.69 \pm 3.12$ vs. $\mu = 17.5 \pm 4.05$; $U = 1496.0$, $p < 0.001$) and sexual effects ($\mu = 16.44 \pm 2.41$ vs. 14.63 ± 4.12; $U = 3440.0$, $p < 0.01$). The groups did not differ on entactogenesis ($\mu = 12.56 \pm 2.43$ vs. $\mu = 11.89 \pm 0.02$; $U = 4390.0$, $p > 0.05$) and prosocial effects ($\mu = 15.81 \pm 2.29$ vs. $\mu = 16.12 \pm 2.73$; $U = 4275.5$, $p > 0.05$) component scores.

As a between groups comparison had found differences in component score, logistic regression (backwards stepwise model) was performed to investigate whether derived E-EXP component score predicted ecstasy user status. The model ($R^2_L = 0.109$, $p < 0.001$) showed that perceptual alterations ($\exp(\beta) = 0.792$, $p < 0.01$), negative intoxication effects ($\exp(\beta) = 0.702$, $p < 0.01$) and sexual effects ($\exp(\beta) = 0.882$, $p < 0.05$) were significant predictors of ecstasy use (i.e. respondents who reported using ecstasy had lower perceptual alteration scores, negative intoxication effects and sexual effects than abstainers).

In order to correct for skewness, ecstasy use parameters were ($\log(x + 1)$) transformed, and Spearman's correlations were performed between these variables and E-EXP components. There were significant negative (inverse) associations between perceptual alterations, and days of ecstasy use in a typical month in the previous year ($r = -0.142$, $p < 0.05$), estimated lifetime use ($r = -0.252$, $p < 0.01$) and duration of use ($r = -0.229$, $p < 0.01$). There were significant inverse correlations between aesthetic and mood effects and lifetime use ($r = -0.131$, $p < 0.05$) and duration of use ($r = -0.156$, $p < 0.01$). Finally, there were inverse correlations between negative intoxication effects and days of use in a typical month ($r = -0.216$, $p < 0.01$), use per episode ($r = -0.166$, $p < 0.01$), lifetime use ($r = -0.217$, $p < 0.01$) and duration of use ($r = -0.229$, $p < 0.01$). Backward stepwise linear regression models with transformed ecstasy parameters serving as dependent (outcome) variables and components as independent (predictor) variables detected no significant relationships.

Table 3 Correlations between reported lifetime use of drugs in ecstasy users ($n = 268$) and in parenthesis the total sample ($n = 305$)

	Alcohol	Amphetamine	Cannabis	Cigarettes	Cocaine	Ecstasy	Ketamine	LSD
Alcohol	–	0.23** (0.20**)	0.09 (0.05)	0.20** (0.18**)	0.24** (0.21**)	0.16* (0.09)	0.13* (0.10)	0.01 (−0.02)
Amphetamine	0.23** (0.20**)	–	0.17** (0.24**)	0.14* (0.17**)	0.53** (0.57**)	0.49** (0.56**)	0.32** (0.36**)	0.43** (0.48**)
Cannabis	0.09 (0.05)	0.35** (0.24**)	–	0.29** (0.25**)	0.17** (0.22**)	0.14* (0.26**)	0.15* (0.19**)	0.13* (0.20**)
Cigarettes	0.20* (0.18**)	0.14* (0.17**)	0.29** (0.25**)	–	0.14* (0.18**)	0.15* (0.21**)	0.06 (0.09)	0.10 (0.14*)
Cocaine	0.24** (0.21**)	0.53** (0.57**)	0.17** (0.22**)	0.14* (0.18**)	–	0.51** (0.57**)	0.35** (0.38**)	0.44** (0.49**)
Ecstasy	0.16* (0.09)	0.49** (0.56**)	0.14* (0.26**)	0.15* (0.21**)	0.51** (0.57**)	–	0.43** (0.46**)	0.44** (0.50**)
Ketamine	0.36** (0.10)	0.32** (0.36**)	0.14* (0.19**)	0.06 (0.09)	0.35** (0.38**)	0.43** (0.46**)	–	0.36** (0.38**)
LSD	0.01 (−0.02)	0.43** (0.48**)	0.41** (0.20**)	0.10 (0.14*)	0.44** (0.49**)	0.44** (0.50**)	0.36** (0.38**)	–

Shown are correlation coefficients (Spearman's rho) for use parameters of the most common substances. Alcohol, cannabis and cigarettes refer to use in the previous week *$p < 0.05$, **$p < 0.01$.

Table 4 Correlations between estimated lifetime drug consumption and use per episode and use/week in ecstasy users

Lifetime use of drug	Use/episode	Use/month
Alcohol (units/week)	0.45***	0.62***
Amphetamine	0.56***	0.57***
Cannabis (joints/week)	0.44***	0.75***
Cigarettes (per week)	0.70***	0.82***
Cocaine	0.60***	0.54***
Ketamine	0.71***	0.66***
LSD	0.44***	0.37***

Alcohol, cannabis and cigarettes refer to use in the previous week.
Shown are correlation coefficients (Spearman's rho).
***$p < 0.001$.

The majority of ecstasy users reported regular simultaneous use of other substances (alcohol 4.8%, cannabis 32.7%, hallucinogens 10.4%, psychostimulants 7.4% and other substances 5.6%). Thirty nine per cent of users reported regularly taking ecstasy alone, although all but ten reported having mixed substances at some time in their careers. An analysis of variance examining between-group variation in component scores across all six groups of users and multinomial logistic regression that examined concomitant use as a function of component scores were both non-significant (data not shown).

As most ecstasy users reported polysubstance use, significant correlations between parameters of use of the most popular drugs and component scores were identified by performing Spearman's correlation and then entered into a backwards stepwise linear regression model. Although several correlator variables were identified, none of these retained their significance in the regression model (data not shown).

Gender differences in ecstasy use variables were examined with t-tests. Males reported greater lifetime use of ecstasy ($\mu = 139.2 \pm 319.2$ vs. $\mu = 54.2 \pm 86.1$; $t = 3.254$, $p < 0.01$) but were similar to females with respect to other use parameters, and there was no gender difference in scores on any of the components. Within abstainers, females had reported significantly higher scores on perceptual effects ($\mu = 18.4 \pm 2.5$, $n = 24$ vs. $\mu = 16.5 \pm 2.6$, $n = 11$; $U = 76.0$, $p < 0.05$), but similar scores on other components. Further analysis showed no interactions between gender, ecstasy use status, and component scores (data not shown).

Reasons given for ecstasy use are displayed in Table 6. From the primary reason given for ecstasy use, subjects were classified according to whether use function was 'recreational' ($n = 128$; aid dancing, sociable, fun, music, rave), or 'structured' ($n = 128$; examination of ASC, enhancement of sex, personal or group psychotherapy, creativity, to feel close to nature, spiritual inquisition, 'other'). Logistic regression (backwards stepwise) showed that entactogenesis ($\exp(\beta) = 1.116$, $p < 0.05$) and perceptual alterations ($\exp(\beta) = 0.923$, $p < 0.05$) were significant predictors of ecstasy use function, with entactogenesis predicting ASC, and perceptual alterations predicting recreational use. Mann Whitney U-Tests were run to examine whether those individuals endorsing more specific use functions scored differently on one or more component score. These were followed by backwards, stepwise logistic regression analyses to identify predictive factors. Respondents reporting primarily using ecstasy at raves reported greater aesthetic and negative intoxication effects ($\exp(\beta) = 1.103$, 1.091; $p < 0.05$ respectively), and those using ecstasy primarily to enhance sex scored higher on the sexual effects component ($\exp(\beta) = 1.155$, $p < 0.001$ with reference to non-endorsees) (see Table 6). Multinomial logistic regression (pseudo $R^2 = 0.339$, $p < 0.05$) with primary function of ecstasy use as the dependent variable showed that perceptual alterations ($\exp(\beta) = 1.334$, $p < 0.05$), aesthetic and mood effects ($\exp(\beta) = 0.732$, $p < 0.05$) and sexual effects ($\exp(\beta) = 1.353$, $p < 0.05$) were significant covariates for individuals who reported enhancement of sex as a primary use function. Logistic regression showed that duration of use and lifetime use of ecstasy were significant predictors of many endorsed ecstasy use functions (see Table 6 for details), although as multinomial regression revealed no significant predictive covariate variables for primary ecstasy use function (pseudo $R^2 = 0.339$, $p > 0.05$), it is likely that this was a general relationship, and therefore it may not be possible to discriminate ecstasy use function on the basis of ecstasy use parameters.

Chi-square tests were performed to examine whether the most popular ecstasy use functions were expressed in specific locations. However, no consistent pattern emerged (data not reported), suggesting that ecstasy use function could not be determined on the basis of preferred or usual use location. Similarly, applying the Kruskal Wallis test failed to find an association between usual location for ecstasy use and specific patterns of E-EXP component scores (data not shown).

Discussion

An examination of responses to a survey of acute ecstasy effects completed by a heterogeneous sample of polysubstance misusers revealed six main components. These components consisted of (i) perceptual alterations; (ii) entactogenesis; (iii) prosocial effects; (iv) aesthetic and mood effects; (v) negative intoxication effects; and (vi) sexual effects. Preliminary analysis of the derived E-EXP scale showed that this instrument has good psychometric properties and with future work in larger populations may be a promising instrument for further research. Future research may also allow for refining and improving component scale reliability. More experienced ecstasy users endorsed fewer negative, perceptual and aesthetic effects. Derived E-EXP score predicted ecstasy use status; naive individuals expected greater perceptual alterations, aesthetic and mood effects, negative intoxication and sexual effects, than those who reported use of ecstasy. As hypothesized, use function (i.e. the reasons individuals gave for taking ecstasy) was associated with different patterns of component scores. However, there was no association between location of ecstasy use and E-EXP score and, contrary to expectations, no specific patterns of use and use function emerged.

People who reported using ecstasy were more likely to have

Table 5 Ecstasy experiences questionnaire components

Item	Item loading	Higher order loading
1. Perceptual Alterations ($\alpha = 0.70$; 11.6% of variance)		0.82
Everything I look at seems to vibrate or pulse when I am on ecstasy	0.72	
Auditory images (mental images that I create in response to things that I hear) are more vivid when I am on ecstasy	0.62	
Ecstasy makes me feel beyond or outside of time	0.61	
I see complex visual imagery and patterns when I am ecstasy, but I know these are a product of my mind	0.60	
On ecstasy I think more in images than abstract thoughts	0.41	
2. Entactogenesis ($\alpha = 0.66$; 10.3% of variance)		0.61
On ecstasy I can deliberately generate insights concerning myself, my personality, and my relationships with other people	0.77	
Ecstasy produces a sense of reverence in me	0.60	
My memory for otherwise forgotten things is strong on ecstasy	0.53	
I have a transcendental experience on ecstasy. I feel detached from all problems, anxieties and human interactions	0.41	
3. Prosocial effects ($\alpha = 0.68$; 10.0% of variance)		0.71
When I am on ecstasy I have strong feelings of caring or compassion for people who I am with	0.76	
I feel more connected to other people when I am on ecstasy	0.72	
When I have taken ecstasy I feel an increased ease and enjoyment of talking to and understanding people	0.64	
Ecstasy lowers my inhibitions so that I say and do things I'm normally too inhibited to do	0.49	
4. Aesthetic and mood effects ($\alpha = 0.62$; 9.7% of variance)		0.68
On ecstasy it is pleasurable to move and dance	0.76	
Ecstasy makes the temperature of things take on new qualities	0.66	
If I try to smell something I can do so more vividly then when off ecstasy	0.59	
I play childish games with others when I have taken ecstasy	0.52	
On ecstasy, wherever I am looks especially beautiful	0.47	
I have the sense that in order to describe parts of the ecstasy experience I would have to use statements that appear to be illogical, involving contradictions and paradoxes	0.41	
5. Negative intoxication effects ($\alpha = 0.64$; 9.5% of variance)		0.66
When I am on ecstasy I find that I have problems remembering things	0.80	
I have difficulty focusing upon one thing at a time when I am on ecstasy	0.73	
I find it hard to take on ordinary social roles when I have taken ecstasy	0.78	
Ecstasy gives me headaches	0.68	
After the ecstasy high is over I become depressed or 'burned out'	0.50	
I get anxious when I am on ecstasy	0.49	
I sweat excessively when I have taken ecstasy	0.42	
6. Sexual Effects ($\alpha = 0.62$; 9.1% of variance)		0.69
Sexual orgasm has new qualities when on ecstasy	0.83	
Sexual orgasm is difficult to achieve when on ecstasy (negatively scored)	0.83	
I find it hard to remain physiologically stimulated during sex (e.g. male erection/female lubrication) if I have taken ecstasy (negatively scored)	0.81	
I feel that when I have taken ecstasy I'm in much closer mental contact with my partner during sex	0.78	
I am willing to sexually experiment when I have taken ecstasy	0.56	

Shown are Cronbach's alphas, explained variance, and component loadings.

used other substances as well, including cannabis and LSD. These findings are similar to associations between ecstasy use and poly-substance use (Butler and Montgomery, 2004; Scholey *et al.*, 2004; Sumnall *et al.*, 2004) in a sample more diverse than the samples examined in previous reports. These findings emphasize the difficulty of classifying substance users on the basis of their behaviour with respect to a particular substance.

Due to the relatively recent history of ecstasy, we were able to recruit a variety of individuals from wide-ranging backgrounds and professions who had used the drug both legally and illegally (examination of time elapsed since last episode and component score showed that there was apparently no recall bias in drug effects). Accordingly, respondents reported using ecstasy for a variety of reasons, most frequently for raves, dancing and

Table 6 Reasons given for using ecstasy and association with component score and ecstasy/MDMA use variables

		Between groups comparison				Logistic regression			
Function	N (%)	Positively scored components[1]	U	Negatively scored components[2]	U	Significant components	exp(β)	Significant ecstasy use variables	exp(β)
Spiritual	65 (21.4)	Entactogenesis	4909.0**	Negative intoxication	5150.5**	Entactogenesis	1.21***	Duration of use	1.84*
						Prosocial	0.88*		
						Negative Intoxication	0.89**		
To produce ASC	212 (69.7)	–	–	–	–	Entactogenesis	1.13*	–	–
						Aesthetic	0.90*		
Enhance sex	88 (28.9)	Sexual effects	5384.0***	–	–	Sexual effects	1.16***	Lifetime use	2.23***
Dancing	180 (59.2)	Perceptual alteration	6799.0*	–	–	–	–	Lifetime use	1.98**
		Aesthetic	6619.5*						
		Negative intoxication	6424.0*						
Personal 'psychotherapy'	127 (41.6)	Entactogenesis	6019.0***	–	–	Entactogenesis	1.24***	Duration of use	2.59***
		Aesthetic	7573.0*						
Group 'psychotherapy'	73 (24.0)	Entactogenesis	5296.0**	–	–	Entactogenesis	1.15**	Lifetime use	1.87*
Creative	89 (29.3)	Entactogenesis	6016.5**	–	–	Entactogenesis	1.06**	–	–
Sociable	161 (53.0)	Prosocial	6444.5***	–	–	Prosocial	1.16**	–	–
		Aesthetic	7006.0**			Negative intoxication	1.08*		
		Negative intoxication	6895.0**						
Close to nature	69 (22.7)	Entactogenesis	5223.5**	Negative intoxication	5495.0*	Entactogenesis	1.16**	–	–
						Negative intoxication	0.91**		
Fun (but not raving)	128 (42.1)	–	–	–	–	–	–	–	–
To enjoy music	170 (55.9)	Perceptual alterations	6648.0**	–	–	Perceptual alteration	1.09*	–	–
		Aesthetic	6886.5*						
Raves	171 (58.3)	Aesthetic	6926.5*	–	–	Aesthetic	1.13*	Lifetime use	2.77***
		Negative intoxication	6455.0**			Negative Intoxication	1.09*		

Volunteers could endorse more than one function, hence totals exceed the number of subjects. Between groups comparisons refers to statistical analyses conducted between groups of ecstasy user reporting different primary use functions. [1]Individuals endorsing this function scored higher on this component than other ecstasy users; [2]Individuals endorsing this function scored lower on this component than other ecstasy users; ASC, altered state of consciousness; shown are Mann Whitney U values for between groups comparison and exp(β) (odds ratio) for logistic regression; $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

enjoyment of music, to be sociable, to produce altered states of consciousness and for self-defined personal psychotherapy. The popularity of this latter function was interesting, and responses may have in part reflected the large media interest in potential use of MDMA in treatment of PTSD (see Introduction; e.g. the *Guardian* (UK) 24/11/2003). More detailed analysis showed that use function predicted component score. There was specificity in this response in that (for example) individuals reporting use in raves or for dancing reported greater aesthetic effects (including items relating to movement), individuals taking MDMA/ecstasy to be sociable reported greater prosocial effects (e.g. gregariousness, empathy, lowering of interpersonal defences) and those reporting use of MDMA/ecstasy for sexual facilitation reported more frequently experiencing items on the sexual effects component (e.g. items relating to sexual orgasm, and the subjective experiences of sex). In contrast, the results of linear regression indicated that individuals reporting use of MDMA/ecstasy for spiritual purposes or to feel closer to nature were less likely to experience negative intoxication effects (items relating to physical discomfort and mental confusion), than their counterparts using MDMA/ecstasy for raving or to be sociable (which are not mutually exclusive activities). We speculate that these particular negative effects (e.g. difficulty concentrating and taking on usual social roles) may be more noticeable in the recreational arena as they interfere with familiar social behaviours, and may be potentiated when combined with extended periods of dancing. Furthermore, expectations may have been primed by the frequent media reference to negative ecstasy effects (acute and long term). Those individuals using the drug for other purposes (i.e. 'nature'/'spirituality') may adopt strategies to counteract negative effects or withdraw from social interactions as part of their drug use practice.

As predicted, people reporting different use functions for ecstasy reported differences in the type and degree of subjective experiences of ecstasy. However, it does not appear that differences in reported function of ecstasy result in differences in chosen environment for ecstasy use, with most respondents reporting use in entertainment venues or in private homes. One reason for this was that subjects reported several different usual locations of use, it may also be that specific goals draw people to attend to or foster specific subjective effects. It was also notable that the number of functions of ecstasy exceeded the number of ecstasy use locations and it is possible that more than one function may occur at a specific location. Goals and use functions may influence what people attend to in an environment, so that the same setting may be experienced differently as a result of different goals. The perceptual effects component was more highly weighted for people who reported that they used ecstasy while dancing or to listen to music, and was not an important component for people who used ecstasy for socializing, personal psychotherapy or other activities not directly associated with club and/or rave attendance. This may be due in part to differences in setting. In the rave party, partygoers expect and seek out the perceptual experience produced by the interaction between drugs and environmental stimuli such as loud music and complex light displays. In common with the 'New Age Seekers' of Watson and Beck (1991), individuals indicating 'spiritual' reasons for ecstasy use most frequently reported insight oriented effects, but unlike this earlier population of users, who only took ecstasy sporadically or on a few separate occasions, respondents in this study reported ingestion patterns similar to other types of user. The difference between the two behaviours may be related to changes in drug culture over time, but may also correspond to personally defined notions of spirituality and a renewed interest in syncretic spiritual matters previously absent in young partygoers.

There have been several reports concerning tolerance to the subjective effects of ecstasy over time. Findings that use history was significantly associated with lower E-EXP component score are in agreement with these reports (Topp *et al.*, 1999). Reduced negative intoxication effects reported by heavier users were not unsurprising, as in cognitive cost/benefit analyses, positively perceived effects (i.e. perceptual and aesthetic components) need to be sufficiently salient and more frequently experienced than negative effects (i.e. negative intoxication) in order to maintain use (Sumnall *et al.*, 2004). There is also indirect supportive evidence within the pre-clinical literature (Cole and Sumnall, 2003b). In rhesus monkeys chronic self-administration of MDMA attenuated its reinforcing effects (Fantegrossi *et al.*, 2004), and in rodents, sub-chronic administration of a low dose of MDMA (1 mg/kg) diminished the usual anxiolytic-like effects of the drug (Navarro and Maldonado, 2002). Only those individuals unperturbed by this may continue their use. It would be interesting to examine this population further to investigate whether, as has been previously suggested in the literature, there are also differences related to use history with respect to sub-acute MDMA effects (Curran and Travill, 1997). Whilst it is not possible to offer meaningful comment upon the mechanistic processes underlying apparent 'tolerance' towards perceptual and aesthetic changes (e.g. cognitive familiarity vs. pharmacological/physiological tolerance (Zacny *et al.*, 1990)), the relative initial novelty and uniqueness of the MDMA/ecstasy subjective experience, and the tendency for less experienced users to consume MDMA in isolation (i.e. without co-administering other substances), may provide one coherent explanation. Although there is no convincing evidence that MDMA causes dependence (Cole and Sumnall, 2003a), individuals wishing to change their use behaviours may be counselled to focus upon the impact of particular drug experiences that they dislike (Baggott, 2002).

Although in this work we did not recruit an equivalent number of control subjects (abstainers from ecstasy), the intent of this paper was to explore and describe subjective experiences of ecstasy that could potentially be developed and used both with ecstasy users and those who have not reported any use of ecstasy. The derived E-EXP will now be validated in larger populations, and for investigations of health beliefs about ecstasy, examining expectations about subjective effects in greater detail, and to see whether differences in subjective effects of ecstasy vary with substance use disorders or with different personality types. As relatively few control subjects were recruited, it still remains to be seen whether expectation of negative outcome predicts abstention from ecstasy. Nevertheless, individuals who had not used ecstasy made higher estimates of the frequency of perceptual alterations

and negative intoxication effects than users. While this finding would seem to support the importance of providing information about negative drug effects as a drug abuse prevention strategy, such an interpretation may be misguided. This relationship may also reflect the fact that ecstasy users may be comparing ecstasy effects to the effects of other drugs, since they had also used a wide array of psychoactive substances. Abstainers' expectations of negative effects from ecstasy compared with their own (possibly positive) experiences of other drugs, or their beliefs that ecstasy may produce similar or amplified effects to those disliked in other drugs, may have prevented use. Furthermore, ecstasy may not serve the specific functions of use chosen by abstainers for use of their other drugs, whether caffeine, cannabis or cocaine. Future work will investigate this topic in more detail. Higher perceptual effects scores in abstainers may have reflected media portrayals of ecstasy as a psychedelic or hallucinogenic drug versus ecstasy users' experience with only slight perceptual alterations. This relationship may also reflect differences in reference points, with ecstasy users potentially comparing ecstasy with other hallucinogens.

Interestingly, there was no gender difference in E-EXP score profile. This was surprising considering that Liechti and colleagues (2001a) reported that an analysis of data pooled across a series of clinical administration studies found that women had greater sensitivity to MDMA-induced perceptual and mood changes than men. One explanation for this discrepancy may be the different inventory items used, with clinical administration studies utilizing generalized clinical scales rather than a measure specifically designed for the effects of ecstasy/MDMA. Second, whilst female respondents in the current study reported a mean of 54.2 episodes of use, the overwhelming majority of Liechti's volunteers were MDMA naive. Polysubstance use, setting of use, familiarity with the acute MDMA/ecstasy intoxication and adoption of strategies to counter negative effects (Shewan *et al.*, 2000), may have contributed to the lack of gender differences in ecstasy effects in this sample.

The content of material sold as ecstasy can vary considerably, with quantity of MDMA varying from 25 to 150 mg per tablet or capsule, and with MDMA either replaced by or combined with other substances, including the related but more hallucinogen-like drug MDA, other methylenedioxy compounds, methamphetamine, caffeine, the dissociative DXM and other substances (e.g. Baggott *et al.*, 2000; Cole *et al.*, 2002b). This raises an interpretational difficulty for the present study. The majority of respondents recruited for this study were polysubstance misusers, and not including the possibility of unwitting polypharmacy, over one third of them reported simultaneous/concomitant substance use. In this respect, and despite instructions to describe ecstasy only, it is important to consider that for many frequent concomitant users, ecstasy effects may not involve MDMA alone. At the least, it may be difficult for respondents accustomed to using ecstasy in combination with other drugs to separate the effects of ecstasy from effects experienced when ecstasy is combined with other substances. It may therefore be more correct to conclude that in discussing the results of this study we are in fact considering the effects of polysubstance misuse within specific use contexts. However, component scores were associated with particular ecstasy use parameters, and not simultaneous or temporally coincidental substance misuse, indicating that users were likely selecting ecstasy-relevant items of the E-EXP. This may largely be a result of the unique behavioural effects of MDMA, which distinguish it from the classic hallucinogens and psychostimulants (Cole and Sumnall, 2003a). Whilst retrospective studies such as this may have a greater likelihood of detecting the array of subjective effects produced by ecstasy compared to clinical MDMA administration, they are still fraught with a number of flaws and difficulties (Cole *et al.*, 2002a). These include questions about the identity and purity of ecstasy consumed by respondents, and differences in sample demographics, often created by the use of 'snowball' and 'word of mouth' sampling. We attempted to prevent or reduce the risk of homogeneous sampling by recruiting individuals from a wide variety of backgrounds and substance use patterns using numerous techniques. This resulted in a population reporting a wide variety of use functions and sociodemographic characteristics, i.e. respondents were not limited to young people involved in the rave lifestyle. In fact in this respect, this study may offer a fuller picture of the ecstasy using population than other retrospective reports that tend to sample from among a specific group of users, often those found at clubs and dance events (Parrott and Lasky, 1998;Parrott *et al.*, 2001; Tossmann *et al.*, 2001; Curran *et al.*, 2004). It is therefore important for researchers to note that rave attendees do not constitute the only set of ecstasy users (Fendrich *et al.*, 2003), and whilst they offer a conveniently sampled population for study, advice and information about ecstasy targeted towards this group may not be appropriate for others.

Conclusion

In studying the consequences of taking MDMA/ecstasy we are probably describing the interaction between social history, and psychopharmacology (including polysubstance misuse), environmental context, use function, effect expectancies and individual personality traits. In order to provide accurate information to drug users it is essential that we recognize and incorporate inter-individual differences in drug experience. It is clear from viewing the results of this study that different use functions lead people to attend to specific aspects of the ecstasy experience. People may pursue these goals in the same settings and venues, but it is possible that they use these settings differently. Setting of use may not be as important as originally believed, though future research should continue to investigate the significance of setting on ecstasy effects. People using ecstasy while dancing or to be social may be more interested in hearing harm reduction information focusing on ways of reducing negative effects. However, people who are not as attentive to negative effects, as those using ecstasy in self-defined therapeutic or spiritual context, may be less interested in this information.

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References

Aust R, Sharp C, Goulders C (2003) Prevalence of drug use: key findings from the 2001/2002 British Crime Survey. 182. Home Office Research Findings, Home Office, London

Baggott M J (2002) Preventing problems in Ecstasy users: reduce use to reduce harm. Journal of Psychoactive Drugs *34*: 145–162

Baggott M, Heifets B, Jones R T, Mendelson J, Sferios E, Zehnder J (2000) Chemical analysis of ecstasy pills. Journal of the American Medical Association *284*: 2190

Boys A, Marsden J (2003) Perceived functions predict intensity of use and problems in young polysubstance users. Addiction *98*: 951–963

Boys A, Marsden J, Strang J (2001) Understanding reasons for drug use among young people: a functional perspective. Health Education and Research *16*: 457–469

Boys A, Marsden J, Griffiths P, Fountain J, Stillwell G, Strang J (1999) Substance use amongst young people: the relationship between perceived functions and intentions. Addiction *94*: 1043–1050

Butler G K, Montgomery A M (2004) Impulsivity, risk taking, and recreational 'ecstasy' (MDMA) use. Drug and Alcohol Dependence 76: 55–62

Cami J, Farre M, Mas M, Roset P N, Poudevida S, Mas A, San L, de la Torre R (2000) Human pharmacology of 3,4-methylenedioxymethamphetamine ('ecstasy'): psychomotor performance and subjective effects. Journal of Clinical Psychopharmacology *20*: 455–466

Cohen R S (1995) Subjective reports on the effects of the MDMA ('ecstasy') experience in humans. Progress in Neuropsychopharmacology and Biological Psychiatry *19*: 1137–1145

Cole J C, Sumnall H R (2003a) Altered states: the clinical effects of Ecstasy. Pharmacology and Therapeutics *98*: 35–58

Cole J C, Sumnall H R (2003b) The pre-clinical behavioural pharmacology of 3,4-methylenedioxymethamphetamine (MDMA). Neuroscience and Biobehavioural Reviews *27*: 199–217

Cole J C, Sumnall H R, Grob C S (2002a) Sorted: ecstasy facts and fiction. The Psychologist *15*: 464–474

Cole J C, Bailey M, Sumnall H R, Wagstaff G F, King L A (2002b) The content of ecstasy tablets: implications for the study of their long-term effects. Addiction *97*: 1531–1536

Condon J, Smith N (2003) Prevalence of drug use: key findings from the 2002/2003 British Crime Survey. 229. Home Office, London.

Curran H V, Travill R A (1997) Mood and cognitive effects of ±3,4-methylenedioxymethamphetamine (MDMA, 'ecstasy'): week-end 'high' followed by mid-week low. Addiction *92*: 821–831

Curran H V, Rees H, Hoare T, Hoshi R, Bond A (2004) Empathy and aggression: two faces of ecstasy? A study of interpretative cognitive bias and mood change in ecstasy users. Psychopharmacology *173*: 425–433

Davison D, Parrott A C (1997) Ecstasy (MDMA) in recreational users: self-reported psychological and physiological effects. Human Psychopharmacology *12*: 221–226

Fantegrossi W E, Woolverton W L, Kilbourn M, Sherman P, Yuan J, Hatzidimitriou G, Ricaurte G A, Woods J H, Winger G (2004) Behavioral and neurochemical consequences of long-term intravenous self-administration of MDMA and its enantiomers by rhesus monkeys. Neuropsychopharmacology *29*: 1270–1281

Fendrich M, Wislar J S, Johnson T P, Hubbell A (2003) A contextual profile of club drug use among adults in Chicago. Addiction *98*: 1693–1703

Field A (2000) Discovering statistics using SPSS for Windows. Sage, London

Forsyth A J (1996) Places and patterns of drug use in the Scottish dance scene. Addiction *91*: 511–521

Fraioli S, Crombag H S, Badiani A, Robinson T E (1999) Susceptability to amphetamine-induced locomotor sensitization is modulated by environmental stimuli. Neuropsychopharmacology *20*: 533–541

Gamma A, Jerome L, Liechti M, Sumnall H R (2005) Is ecstasy perceived to be safe? A web based survey and review of the literature. Drug and Alcohol Dependence *77*: 185–193

Green A R, Mechan A O, Elliott J M, O'Shea E, Colado M I (2003) The pharmacology and clinical pharmacology of 3,4-methylenedioxymethamphetamine (MDMA, 'ecstasy'). Pharmacological Reviews *55*: 463–508

Greer G R, Tolbert R (1998) A method of conducting therapeutic sessions with MDMA. Journal of Psychoactive Drugs *30*: 371–379

Hansen D, Maycock B, Lower T (2001) 'Weddings, parties, anything…', a qualitative analysis of ecstasy use in Perth, Western Australia. International Journal of Drug Policy *12*: 181–199

Harris D S, Baggott M, Mendelson J H, Mendelson J E, Jones R T (2002) Subjective and hormonal effects of 3,4-methylenedioxymethamphetamine (MDMA) in humans. Psychopharmacology *162*: 396–405

Hermle L, Spitzer M, Borchardt D, Kovar K A, Gouzoulis E (1993) Psychological effects of MDE in normal subjects: are entactogens a new class of psychoactive agents? Neuropsychopharmacology *8*: 171–176

Holland J (2001) Ecstasy: The Complete Guide. Park Street Press, Rochester, VT

Jaccard J, Wan C K (1996) LISREL approaches to interaction effects in multiple regression. Sage Publications, Thousand Oaks, CA

Johnston L D, O'Malley P M, Bachman J G (2002) Rise in ecstasy use among American teens begins to slow. University of Michigan News and Information Services, Ann Arbor, MI

Liechti M E, Vollenweider F X (2001) Which neuroreceptors mediate the subjective effects of MDMA in humans? A summary of mechanistic studies. Human Psychopharmacology *16*: 589–598

Liechti M E, Gamma A, Vollenweider F X (2001a) Gender differences in the subjective effects of MDMA. Psychopharmacology *154*: 161–168

Liechti M E, Geyer M A, Hell D, Vollenweider F X (2001b) Effects of MDMA (ecstasy) on prepulse inhibition and habituation of startle in humans after pretreatment with citalopram, haloperidol, or ketanserin. Neuropsychopharmacology *24*: 240–252

Liester M B, Grob C S, Bravo G L, Walsh R N (1992) Phenomenology and sequelae of 3,4-methylenedioxymethamphetamine use. Journal of Nervous and Mental Disease *180*: 345–352

MacAndrew C, Edgerton R B (1969) Drunken Comportment: A Social Explanation, 1st edn. Aldine Publishing Company, Chicago, IL

McDermott P (1993) MDMA use in the north west of England. International Journal of Drug Policy *4*: 210–221

Metzner R, Adamson S (2001) Using MDMA in Healing, Psychotherapy and Spiritual Practice. In Holland J (ed.), Ecstasy: The complete guide. Inner Traditions, Rochester, VT, pp. 182–207

Mithoefer M (2003) MDMA-assisted psychotherapy in the treatment of posttraumatic stress disorder (PTSD): a third update on the approval process. MAPS Bulletin *13*: 7–8

Navarro J F, Maldonado E (2002) Acute and subchronic effects of MDMA ('ecstasy') on anxiety in male mice tested in the elevated plus-maze. Progress in Neuropsychopharmacology and Biological Psychiatry *26*: 1151–1154

Pahnke W, Richards W (1966) Implications of LSD and experimental mysticism. Journal of Religion and Health *5*: 175–208

Parrott A C, Lasky J (1998) Ecstasy (MDMA) effects upon mood and cognition: before, during and after a Saturday night dance. Psychopharmacology *139*: 261–268

Parrott A C, Stuart M (1997) Ecstasy (MDMA), amphetamine, and LSD: comparative mood profiles in recreational polydrug users. Human Psychopharmacology *12*: 501–504

Parrott A C, Milani R M, Parmar R, Turner J D (2001) Recreational ecstasy/MDMA and other drug users from the UK and Italy: psychiatric symptoms and psychobiological problems. Psychopharmacology *159*: 77–82

Peroutka S J, Newman H, Harris H (1988) Subjective effects of 3,4-methylenedioxymethamphetamine in recreational users. Neuropsychopharmacology *1*: 273–277

Rhodes T (1996) Culture, drugs and unsafe sex: confusion about causation. Addiction *91*: 753–758

Schafer J, Brown S A (1991) Marijuana and cocaine effect expectancies and drug-use patterns. Journal of Consulting and Clinical Psychology *59*: 558–565

Scholey A B, Parrott A C, Buchanan T, Heffernan T M, Ling J, Rodgers J (2004) Increased intensity of Ecstasy and polydrug usage in the more experienced recreational Ecstasy/MDMA users: a WWW study. Addictive Behaviours *29*: 743–752

Shewan D, Dalgarno P, Reith G (2000) Perceived risk and risk reduction among ecstasy users; the role of drug, set and setting. International Journal of Drug Policy *10*: 431–453

Siegel R K (1986) MDMA. Nonmedical use and intoxication. Journal of Psychoactive Drugs *18*: 349–354

Solowij N, Hall W, Lee N (1992) Recreational MDMA use in Sydney: a profile of 'Ecstasy' users and their experiences with the drug. British Journal of Addiction *87*: 1161–1172

Stevens S (1997) Speaking the silence: MDMA in a couple dealing with cancer. MAPS Bulletin *7*: 6–10

Stevens S (1999) MDMA in a couple struggling with cancer: Two years later. MAPS Bulletin, *9*: 15–17

Stevens S (2000) MDMA and a couple struggling with cancer: Sue's final letter. MAPS Bulletin *9*: 31–34

Stolaroff M J (1997) The Secret Chief: Conversations with a pioneer of the underground psychedelic therapy movement. MAPS, Charlotte, NC

Sumnall H R, Wagstaff G F, Cole J C (2004) Self-reported psychopathology in polydrug users. Journal of Psychopharmacology *18*: 63–69

Tancer M, Johanson C E (2003) Reinforcing, subjective, and physiological effects of MDMA in humans: a comparison with d-amphetamine and mCPP. Drug and Alcohol Dependence *72*: 33–44

Tart C (1977) On being stoned. Science and Behavior Books, Palo Alto

Topp L, Hando J, Dillon P, Roche A, Solowij N (1999) Ecstasy use in Australia: patterns of use and associated harm. Drug and Alcohol Dependence *55*: 105–115

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

Verheyden S L, Henry J A, Curran H V (2003) Acute, subacute and long-term subjective consequences of 'ecstasy' (MDMA) consumption in 430 regular users. Human Psychopharmacology *18*: 507–517

Vogel-Sprott M, Fillmore M (1999) Expectancy and behavioural effects of socially used drugs. In Kirsch I (ed.), Expectancy, Experience, and Behavior. American Psychological Association, Washington, DC

von Sydow K, Lieb R, Pfister H, Hofler M, Wittchen H U (2002) Use, abuse and dependence of ecstasy and related drugs in adolescents and young adults-a transient phenomenon? Results from a longitudinal community study. Drug and Alcohol Dependence *66*: 147–159

Watson L, Beck J (1991) New age seekers: MDMA use as an adjunct to spiritual pursuit. Journal of Psychoactive Drugs *23*: 261–270

Williams L, Parker H (2001) Alcohol, cannabis, ecstasy and cocaine: drugs of reasoned choice amongst young adult recreational drug users in England. International Journal of Drug Policy *12*: 397–413

Zacny J P, Virus R M, Woolverton W L (1990) Tolerance and cross-tolerance to 3,4-methylenedioxymethamphetamine (MDMA), methamphetamine and methylenedioxyamphetamine. Pharmacology, Biochemistry, and Behaviour *35*: 637–642

Zemishlany Z, Aizenberg D, Weizman A (2001) Subjective effects of MDMA ('Ecstasy') on human sexual function. European Psychiatry *16*: 127–130