

Ecstasy (MDMA) in Recreational Users: Self-Reported Psychological and Physiological Effects

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Twenty recreational drug users were asked to describe the psychological and physiological effects they experienced under MDMA (3,4-methylenedioxyamphetamine). The subjects comprised 11 males and nine females, in the age range 18–31 years. Five subjects had taken MDMA once, nine had taken it 2–9 times, while six subjects had taken it +10 times. Each subject completed a modified Profile of Mood States Questionnaire (POMS), an Ecstasy Effect Questionnaire, and a structured interview, covering past experience with MDMA. Increased feelings of elation, agreeableness, energy, and mental confusion were reported on-drug ($p < 0.001$), together with faster heart rate, feeling hot, increased sweating and dehydration, dilated pupils, and tight jaw (trismus). Coming off-Ecstasy led to feelings of lethargy, moodiness, insomnia, depression, irritability, and paranoia. Bad MDMA trips were reported by 25 per cent of the sample, following a variety of unpleasant experiences. Chronic pharmacodynamic tolerance was not apparent, since although regular users all described their first MDMA experience as 'the most intense', later trips were affected by knowledge and expectancy, rather than any diminution in drug response. Acute pharmacodynamic tolerance was, however, evident, with a period between drugs being described as necessary in order to maintain drug effectiveness. This may help explain the low addiction potential of MDMA. © 1997 by John Wiley & Sons, Ltd.

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INTRODUCTION

3,4-Methylenedioxyamphetamine (MDMA) is a synthetic amphetamine derivative, with mixed stimulant and hallucinogenic properties (Shulgin, 1986; Solowij, 1993). Neurochemically it has been described as 'messy', with indirect 5-HT₂ receptor agonist actions, combined with a range of effects upon dopamine and other neurotransmitters (McDowell and Kleber, 1994, p. 129). MDMA has been used by recreational drug takers since the mid-1980s, when it became popular at acid house parties, and the subsequent rave scene. It has been given various street names, with Ecstasy or 'E' currently the most widespread (Parrott, 1995). In 1990, Peroutka estimated that several million Ecstasy tablets had been taken worldwide. Since then its use has become even more pervasive, across both the USA (Cuomo *et al.*, 1994), Australia (Solowij *et al.*, 1992), the UK and many other countries (Saunders, 1993).

Despite its widespread use as an illicit social drug, there have been comparatively few scientific studies into its psychological effects: 'Internationally there is a paucity of research regarding the nature of the effects produced by this drug' (Solowij *et al.*, 1992, p. 1162). Some reports have described its potential for therapeutic use, where it has been hypothesized to encourage personal development or aid psychotherapy (Grinspoon and Bakalar, 1986; Millman and Beeder, 1994). Many clinical reports have outlined the medical problems and fatalities it can cause, following hyperthermia, hypertension, convulsions, toxic hepatitis, and psychiatric breakdown (Dowling *et al.*, 1987; Schmidt, 1987; Henry *et al.*, 1992; Lee, 1994; Maxwell *et al.*, 1994; Series *et al.*, 1994).

The effects of MDMA in recreational drug users have also occasionally been described. Downing (1986) monitored the medical and physiological changes in a group of San Francisco volunteers, given MDMA at the home of the researcher. Peroutka *et al.* (1988) studied the effects of

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Ecstasy, as recalled by a sample of American undergraduates, while Solowij *et al.* (1992) undertook a similar study in Australia. The present study was designed to investigate the psychological and physiological effects of MDMA in British recreational drug users. Three assessment measures were used. Firstly, the bipolar Profile of Mood State Questionnaire (Lorr and McNair, 1980), with its response format modified to measure mood changes on-drug (Parrott, 1996). The aim was to describe a standardized mood profile for MDMA, since previous studies have generally focused upon those particular aspects of mood known to be affected by the drug. Secondly, an Ecstasy Effect Questionnaire covered various aspects of MDMA use. Finally, a structured interview covered a number of further topics, including repeated drug use, also acute and chronic tolerance.

METHODS

Subjects

Twenty unpaid subjects were obtained using the 'snowball' technique, developed for illicit drug research (Solowij *et al.*, 1992). A small group of known users was asked to spread word of the study amongst friends and acquaintances who were also MDMA users. The criteria for subject inclusion were that they must have used Ecstasy at least once, and be aged +18 years. The subjects (11 male, nine female) ranged from 18–31 years; 15 were university students, while five were in employment.

Drug conditions

Subjects were asked to base their questionnaire responses upon their past experience with Ecstasy. Five subjects stated that they had taken MDMA once, nine had taken it 2–9 times, while six had taken it 10 times or more (maximum: 200 times over a 5-year period).

Assessment measures

Ecstasy Effect Questionnaire. This was written for the current study, with questions derived from previous research reports (Downing, 1986; Peroutka *et al.*, 1988; Solowij *et al.*, 1992). It covered a range of physiological and psychological experiences, both on and off-Ecstasy.

Profile of Mood States Questionnaire (POMS). This comprised a list of 72 adjectives, covering six bipolar mood factors (Lorr and McNair, 1980); these six factors are listed in Figure 1. The response format was modified to assess feeling state changes on-drug (Parrott, 1996). Subjects were required to tick one of three response alternatives, for each mood adjective:

Most like this when ON-ECSTASY
SAME on-and-off Ecstasy
Most like this when OFF-ECSTASY

Each response was scored: 0, 1 or 2. An overall mood factor score of 12 indicated no mood change. A score greater than 12 (maximum 24) indicated a tendency towards one end of the bipolar scale, while scores of less than 12 (minimum = 0) indicated a trend towards the opposite mood state (Figure 1).

Structured interview

A tape-recorded interview covered a number of prepared questions, including the number of times MDMA had been taken, timing between doses, comparative effects of first and most recent capsule, use of other illicit drugs, and further topics.

Procedure

Each subject was tested individually when they were drug-free, and had not taken any drugs recently. The study aims and objectives were described at the beginning, where it was stated that taking part in the study was entirely voluntary, and that subjects could withdraw at any time. It was emphasized that neither the experimenters nor the University, condoned the taking of illicit drugs, and this study should not be seen as indicting approval for the use of illegal psychoactive drugs. While subjects provided informed consent, all data analysis was by subject number to ensure confidentiality.

RESULTS

Group mean scores for the six POMS mood factors are shown in Figure 1. The significance of paired *t*-test comparisons between mood scores for each factor, with baseline scores of 12 (indicating no mood change on-drug), are also tabulated. Subjects reported feeling significantly more elated ($p < 0.001$), agreeable ($p < 0.001$), energetic

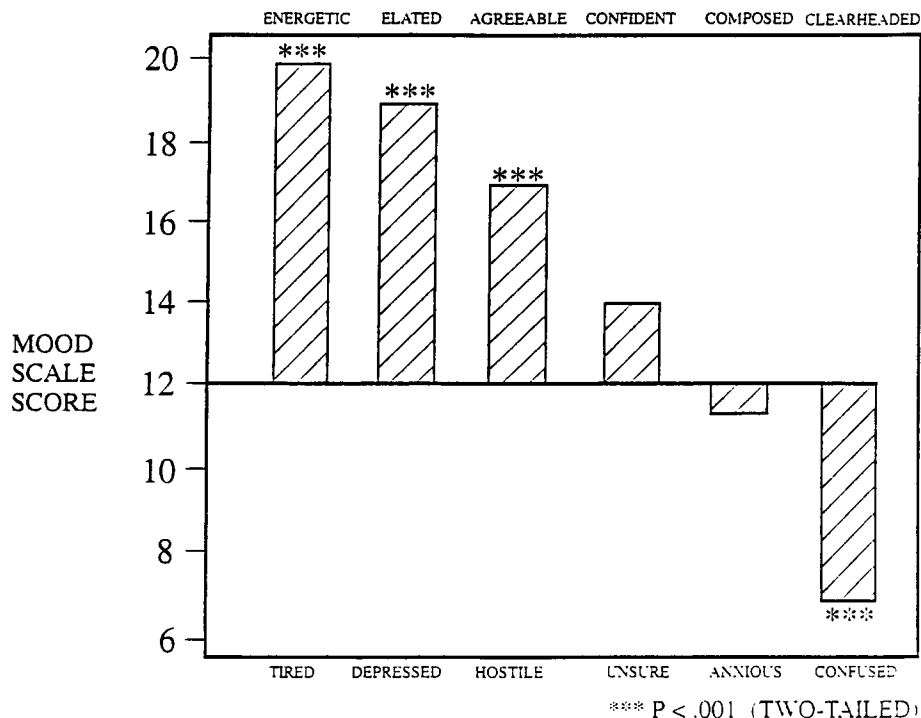


Figure 1. Profile of mood states on-MDMA (Ecstasy), as described by recreational drug users

($p < 0.001$), and confused ($p < 0.001$) while on-Ecstasy. The composure/anxiety, and confidence/uncertainty subscales were unchanged (Figure 1). The Ecstasy Effect Questionnaire findings are summarized in Table 1. Various medical/physiological changes were described: faster heart rate, increased body temperature, sweating and dehydration, dilated pupils, and tight jaw (trismus). Feelings of happiness, exhilaration, and energy, warmth and friendliness, calmness and relaxation, and increased perception of sound, colour and touch, were also noted on-drug (Table 1). In contrast, when coming off-drug, feelings of lethargy, moodiness, irritability, insomnia, depression, and paranoia were described (Table 1). The self-rated duration of these rebound effects varied from a few hours in some subjects, to over a day in others. The structured interview covered several topics, which are discussed more fully in the Discussion. Various street names were given for Ecstasy: White Dove (9), Snowball (5), Disco Biscuit (5), Denace the Menace or Black and Red (4), while 15 other names were mentioned. Subjects admitted to past experience with several other illicit drugs: cannabis (90 per cent), LSD (70 per cent), amphetamine

(65 per cent), cocaine (60 per cent); and others (5–30 per cent).

DISCUSSION

Under MDMA, the recreational drug users reported increased feelings of energy, elation and agreeableness (Figure 1). Similar findings were noted by Peroutka *et al.* (1988) in America, and Solowij *et al.* (1992) in Australia. They found feelings of happiness and euphoria, energy and talkativeness, decreased hostility and aggression, and greater acceptance of others. The POMS profile also showed that some aspects of mood were not affected by MDMA. Thus neither confidence/uncertainty, nor anxiety/composure, were affected by MDMA (Figure 1). However, although the POMS composed-anxious scale was unchanged, 80 per cent of subjects described feelings of calmness and relaxation while on-drug (Table 1); the reason for this discrepancy needs to be investigated. One possibility is that MDMA leads both to feelings of calmness, and to anxiety (Liestner *et al.*, 1992). Increased perception of colour, sound and touch, were also noted under MDMA (Table 1).

Table 1. Self-reported psychological and physiological effects on-MDMA, and coming-off MDMA

	Percentage of subjects reporting effect
Psychological effects on-MDMA	
Happy	100
Exhilarated	100
Warm and Friendly	100
Increased perception of sound	100
Increased perception of touch	95
Increased perception of colour	85
Full of energy	95
Calm and relaxed	80
Talkative	80
Distorted vision	65
Hallucinations	60
Confused thought	50
Physiological effects on-MDMA	
Increased heart rate	100
Dilated pupils	90
Increased body temperature	90
Dehydration	85
Increased sweating	85
Tight jaw muscles	85
Tingling skin	75
Unsteadiness	65
Headache	35
Nausea	25
Vomiting	5
Psychological effects coming-off MDMA	
Lethargy	90
Moodiness	85
Insomnia	85
Irritability	60
Depression	55
Anxiety	40
Paranoia	35

This agrees with Solowij *et al.* (1992), who reported that MDMA users experienced greater 'sensual' feelings and perceptions. The only adverse POMS change found here, was the significant increase in mental confusion while on-drug (Table 1; Figure 1). This agrees with data from studies using objective performance tasks. Krystal *et al.* (1992) reported mild-moderate impairments on a neuropsychological test battery, in eight out of nine regular users of MDMA. Parrott *et al.* (unpublished) also found significantly worse performance on two memory tasks in MDMA users, compared to non-user controls; although performance on other cognitive tasks was not impaired.

The overall mood profile described by MDMA users was therefore rather unique, with alertness, elation, and happiness combined with emotional calmness, but impaired mental functioning. Solowij *et al.* (1992, p.1166) noted that the overall effects of MDMA were broadly positive: 'The most frequently reported effects of Ecstasy fell into the Positive Mood and Intimacy categories, followed by Activation and Insight effects. Negative mood effects were least reported'. However, while earlier studies of recreational users suggested the MDMA use was largely without adverse consequences (Dowling, 1986), more recent studies have investigated its negative effects more carefully. In particular, the serotonergic depletion caused by regular MDMA use, has become an important topic for concern (Ricaurte and McCann, 1992). The question arises as to whether long-term changes in the levels of 5-HT functioning, are related to the altered levels of cognitive ability found with regular MDMA users (Krystal *et al.*, 1992; Parrott *et al.*, unpublished).

Various physiological changes were reported while on-drug: increased heart rate, dilated pupils, increased temperature, sweating, and dehydration (Table 1). MDMA has strong sympathomimetic actions, and this pattern of physiological arousal has been widely noted (Downing, 1986; Peroutka *et al.*, 1988; Solowij *et al.*, 1992; Solowij, 1993; McDowell and Kleber, 1994). Ecstasy ingestion can also lead to hyperthermia, particularly when combined with prolonged dancing in hot and crowded clubs or raves. Many of the deaths caused by MDMA have resulted primarily from heat stroke, although with various contributory factors (Dowling *et al.*, 1987; Schmidt, 1987; Henry *et al.*, 1992; Lee, 1994; Maxwell *et al.*, 1994). Experienced users are generally aware of the problems of hyperthermia, but novice drug users often need to be educated about them. Many rave and club venues therefore now provide leaflets which illustrate the consequences of overexertion, and recommend the regular intake of water. They also have quiet areas where participants can rest and 'chill-out'. The practical effectiveness of providing a cool ambient temperature to preclude the development of MDMA-induced hyperthermia, has been empirically demonstrated in rat studies (Dafters, 1994). This study was also undertaken before the dangers of hyponatraemia were widely known i.e. the dilution of body fluids following excessive water intake (Maxwell *et al.*, 1994); this problem is

now recognized more widely following the tragic death of Leah Betts.

In contrast to the generally positive feelings on-drug, a broad range of negative moods were experienced when coming-off MDMA. Lethargy, depression, moodiness, irritability, and insomnia were noted by most subjects (Table 1), while feelings of paranoia were described by 35 per cent of the sample. Solowij *et al.* (1992) described a similar range of withdrawal symptoms and rebound phenomena: feeling tired, lethargic, spaced-out, irritable, emotional, and depressed. This pattern of positive mood changes on-drug, followed by negative feelings on drug withdrawal, is typical of CNS stimulants (Julien, 1995). Thus amphetamine and cocaine lead to a physical and mental 'high', which is then followed by a period of physical and mental exhaustion. Regular stimulant users take another dose of drug to achieve the next high: hence the cycle of repetitive drug taking or addiction. This raises the question of why MDMA seems to display a weak potential for addictiveness. None of the regular users here stated that MDMA was physically addictive, although several noted that it could be seen as psychologically addictive. One possible reason for this, is the different patterns of acute pharmacodynamic tolerance displayed by amphetamine and MDMA. During amphetamine withdrawal, another dose of drug tends to restore the 'positive' moods, although higher doses may be needed (Julien, 1995). Thus a cycle of regular self-dosing (i.e. amphetamine addiction), readily ensues. In contrast, our MDMA users stated that when tablets were taken in succession, the later capsules did not have beneficial effects. Thus the normal pattern of drug ingestion, was for one trip every 1–4 weeks. This period between-drugs was described as necessary, in order to avoid drug habituation.

Subjects who had taken MDMA more than once, were asked to compare their first trip with their most recent. All reported that their first had been 'the most intense'. However they also stated that subsequent trips were not weaker, just that the nature of the drug-induced changes were known and expected. Thus in contrast to the anecdotal evidence for acute pharmacodynamic tolerance (see previous paragraph), there was no equivalent evidence to suggest chronic pharmacodynamic tolerance. In a similar way, regular users did not report any benefits from increasing the drug dosage. With regard to the effects of repetitive MDMA use upon health, weight loss was

noted by five subjects, which is consistent with the regular consumption of sympathomimetic/anorectic agents. Five subjects also recorded spinal problems and backache. Several subjects reported that they had become more open-minded, and less judgemental of others, following regular MDMA use. However, one subject reported that following a very bad Ecstasy trip, they had become extremely wary of all illicit drugs. This is consistent with other reports of occasional severe and unpleasant experiences with MDMA (Series *et al.*, 1994). Overall, 25 per cent of our subjects reported that they had experienced at least one bad trip on Ecstasy. These reflected a variety of adverse effects: confused thought, paranoia, vomiting, lack of eye control, headache, feeling very hot, panic, fear, feeling out of control, thoughts of death, and feeling immobile.

The main problem with the current study, was that there was no control over which drugs had been taken. This problem has been noted in similar questionnaire studies (Peroutka *et al.*, 1988; Solowij *et al.*, 1992). Thus it is not possible to firmly attribute the self-reported effects to MDMA itself, rather than to possible contaminants, or other drugs sold as MDMA. However, police analysis of drug-squad seizures, has shown that most samples of active MDMA are uncontaminated. Furthermore, when they are impure, the main contaminant is generally MDA (methylenedioxymphetamine), which is neurochemically very similar to MDMA (Stuart and Parrott, unpublished). Overall therefore, the consistency of findings both within and across studies, suggests it is largely MDMA effects that are being described (Downing, 1986; Peroutka *et al.*, 1988; Krystal *et al.*, 1992; Solowij *et al.*, 1992). The other main weakness of the current and similar studies, was that they were not placebo controlled. The self-reported mood changes (Figure 1), may have been influenced by expectancy or context effects. If MDMA is taken when people expect to have a good time, the beneficial mood effects may (partially) reflect this. Some of our regular users also noted the importance of being in a supportive environment to avoid bad trips. In that respect MDMA seems to be similar to LSD, in heightening external environmental influences, and internal cognitive states. If double-blind placebo controlled studies were to be sanctioned, it would be interesting to assess the effects of MDMA in environments with various mood-inducing properties. This would help answer the question of whether

MDMA induces a particular set of mood changes, or simply intensifies the prevailing external (environmental/social), and internal (cognitive/emotional), stimulus conditions.

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