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Mood and Impulsivity of Recreational Ecstasy Users in the Week Following a“ Rave”

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Abstract

Two days following widely attended “rave” or dance party events, questionnaires assessing mood (Beck Depression Inventory, or BDI-II) and impulsivity (Impulsiveness, Venturesomeness and Empathy Scale, or IVE) were completed by 43 attendees who reported using Ecstasy at the events, and by 31 Ecstasy-naive controls who attended the same events. Participants who had taken Ecstasy at the events were significantly more depressed two days later than controls, according to analysis of their BDI-II scores. There was no group difference in impulsivity as measured by the IVE. Levels of self-reported Ecstasy use were not related to depression or impulsivity scores. Results are considered in terms of the hypothetical mood effect of short-term depletion of serotonin induced by MDMA, as well as several alternative non-pharmacological explanations.

KEYWORDS: Ecstasy, MDMA, depression, impulsivity, serotonin

The popular illicit drug 3, 4-methylenedioxymethamphetamine (MDMA, Ecstasy) is a ring-substituted amphetamine with unique “entactogenic” effects (Parrott & Stuart, 1997). The emergence and spread of this drug among the young adult population worldwide has been one of the most significant trends in illicit drug consumption of the past decade (Diemel & Blanken, 1999). Ecstasy is often taken at mass youth gatherings or “raves” and at nightclub-sponsored dance events (Wijngaart, Braam, Bruin & Fris, 1999). Such behaviour has raised concerns about the medical or psychiatric complications that may result from recreational Ecstasy use.

Although adverse acute reactions to typical doses of Ecstasy are rare (Gowing et al., 2002), a transient depressed mood has been reported in Ecstasy users during the week after consuming Ecstasy (Curran & Travill, 1997; Gamma et al., 2000; Hammersley, Ditton, Smith & Short, 1999; Morgan, 1998; Peroutka et al., 1988; Topp, Hando, Dillan, Roche & Solowij, 1999; Wijngaart et al., 1999). Because serotonin deficiency may play a role in the pathogenesis of depression (Staley, Malison & Innis, 1998), post-Ecstasy depressive symptomatology or “mid-week blues” has been attributed to reversible depletion of serotonin following the acute serotonin release induced by MDMA. However, a few studies have reported either no post-Ecstasy mood alterations (Krystal & Price, 1992) or elevated mood in the week after MDMA was administered in a clinical context (Adamson & Metzner, 1988; Greer & Tolbert, 1986). The latter findings suggest that reports of post-Ecstasy depression in recreational users may relate more to the combination of all-night dancing and Ecstasy use, or perhaps other factors such as expectancies stemming from publicity about Ecstasy’s supposed aftereffects, rather than MDMA per se.

Curran and Travill (1997) examined the short-term after-effects of Ecstasy use at an all-night dance party on mood as measured by the Beck Depression Inventory (BDI) and the Profile of Mood States (POMS). Ecstasy users were compared to an alcohol using control group at a Saturday-night dance party, the next day, and five days later. Those who took Ecstasy at the rave party indicated an elevated mood at that time however their mood deteriorated 24 hours later and became even worse five days after the party. Some Ecstasy users' BDI scores indicated mild to moderate clinical depression on day 5. By contrast, the alcohol users indicated middling moods on the Saturday night, then mood ratings were at the worse end of the normal range the next day, but by day 5 mood ratings had returned to their initial levels on day 1. POMS scores revealed that Ecstasy users became progressively more discontented, sad and bored over the successive days of testing. Parrott and Lasky (1998) conducted a similar study assessing the mood levels of Ecstasy users in the week following a Saturday night dance party. Their findings indicated that Ecstasy users and non-user controls felt about the same on the Saturday night, but two days later the Ecstasy users reported a range of negative mood states, including depression, sadness, unsociability, unpleasantness and abnormality; the control group did not show such changes. A pattern of depression, moodiness and irritability may be fairly common in the days following an Ecstasy experience (Peroutka et al., 1998; Solowij et al., 1992), although the reason for this is unclear.

In contrast to the above studies of recreational Ecstasy use, Greer and Tolbert (1986) assessed subjective reports of the acute and residual effects of MDMA administered in a clinical setting. They recruited 29 therapy clients who were referred for an MDMA psychotherapy session. Only phenomenological descriptions were obtained

of the clients' experiences before, during and after the session. Residual mood changes were all positive in nature, lasting from several hours to several weeks, and averaging around one week. Out of the 29 clients assessed, 14 reported an increase in 'good' feelings, with 11 of the participants also feeling relaxed, calm, detached, serene and less agitated. The MDMA experience also reportedly enhanced clients' self-esteem and increased their subjective patience and hopefulness. Such positive after-effects suggest an enduring antidepressant-like response to MDMA when administered for clinical purposes, in contrast to the negative after-effects reported by "ravers." However, a recent pilot study by Barker, Bradnam, Meyer and Lyvers (2003) found a negative relationship between habitual level of Ecstasy use among regular users and depression scores, also suggesting a possible antidepressant-like effect of the drug among recreational users in contrast to the many published reports of depressive post-Ecstasy symptomatology.

Deficient serotonergic system functioning has been consistently associated with impulsivity (Linnoila, Virkkunen, George & Higley, 1993; Soubrie, 1986; Virkkunen & Linnoila, 1993), thus this trait has also been examined in Ecstasy users. Morgan (1998) compared Ecstasy users, who had not taken Ecstasy for a week, to Ecstasy-naïve polydrug user controls with similar drug histories (other than Ecstasy), and to non-illicit drug using controls. Impulsivity was assessed by two measures: a personality test (the Impulsiveness, Venturesomeness and Empathy Scale, or IVE) and a behavioural test (the Matching Figures Test, or MFT). IVE scores indicated that Ecstasy users were significantly more impulsive than non-illicit drug user controls. Ecstasy users also exhibited elevated impulsivity on the behavioural measure, as they committed more errors on the MFT than both control groups. Other studies have reported similar findings

(Callow, 1996; Gerra et al., 1998; Halpern et al., 2004; Parrott, Sisk & Turner, 2000). By contrast, McCann et al. (1994) found that their 30 recreational Ecstasy users exhibited lower levels of impulsivity than non-illicit drug user controls. In other studies a dose-response relationship has been reported (Halpern et al., 2004; Morgan, 1998; Parrott et al., 2000) such that self-reported lifetime amount of Ecstasy consumed was positively related to impulsivity. However this association may reflect pre-drug traits rather than residual MDMA-related neurochemical changes, as substance use in general is positively associated with impulsivity (Lyvers & Hasking, 2004; Zuckerman, Kuhlman, & Camac, 1988). Thus it is unclear whether the higher levels of impulsivity sometimes reported in Ecstasy users are a cause or effect of Ecstasy use, especially when heavy users are considered.

Ecstasy is gaining popularity worldwide, with 20% of the Australian population between the ages of 20 and 29 having tried the drug according to a recent survey (Australian Institute of Health and Welfare, 2003). There is thus a pressing need for further research on the possible adverse effects of uncontrolled Ecstasy use. The majority of recreational Ecstasy users consume this drug on the weekends at raves or nightclubs (Wijngaart et al., 1999). Therefore, it is important to assess the residual effects of the drug in the following week, as users may encounter psychological and perhaps occupational problems during this period. The aim of the present study was to examine the possible residual effects of Ecstasy on mood and impulsivity. Regular Ecstasy users who had consumed Ecstasy on the weekend at raves or a nightclub dance party were compared to Ecstasy-naïve controls who had attended the same events but had used alcohol rather than Ecstasy. This was to control for the residual effects of partying,

including fatigue caused from dancing all night, which might otherwise confound the results. The participants were asked to complete questionnaires assessing mood and impulsivity two days after the rave or dance event, consistent with previous work cited above that had found adverse aftereffects of Ecstasy on mood two days later. Thus based on the previous evidence cited above, we expected that (1) Ecstasy exposed individuals would have higher depression scores than Ecstasy-naive controls, and (2) Ecstasy exposed participants would have higher scores on a measure of impulsivity than Ecstasy-naive controls.

Method

Participants

A total of 74 participants were recruited: 43 recreational Ecstasy users (31 males and 12 females) and 31 Ecstasy-naive controls (15 males and 16 females). All participants were recruited at the end of two raves and a special dance event held at a nightclub. For inclusion in the Ecstasy group the participants had to have consumed Ecstasy at the rave party or dance event, whereas for inclusion in the control group the participants must have never taken Ecstasy. Past use of other illicit drugs by the both groups was acceptable, as Ecstasy users are typically polydrug users (Topp et al., 1999). Alcohol (but not other drug) use at the events was also acceptable in both groups. Exclusionary criteria included self-reported past or present serious medical history, current major psychiatric disorder and drug or alcohol dependence. The current study was approved by the Bond University Human Research Ethics Committee prior to the commencement of data collection.

One-way analyses of variance (ANOVAs) revealed that Ecstasy users and non-user controls were similar in terms of education level and occupational category. Chi-square analysis indicated that there were significantly more males in the Ecstasy group, $\chi^2 = 4.41, p < .05$, as is typically the case in research samples of Ecstasy users (Wijngaart et al., 1999). Ecstasy users were slightly older ($M = 23.63$ yr, $SD = 5.29$) than controls ($M = 21.21$ yr, $SD = 3.83$), $t(72) = 2.22, p < .05$. The Ecstasy group had also attended significantly more raves in the last year ($M = 8.63, SD = 7.20$) than the non-user control group ($M = 1.32, SD = 2.33$), $t(70) = 5.43, p < .01$.

Materials

Each participant received a questionnaire package that included an explanatory statement and three questionnaires: Personal Information Questionnaire, Beck Depression Inventory 2nd Edition (Beck, Steer & Brown, 1996), and the Impulsiveness, Venturesomeness and Empathy Scale (Eysenck & Eysenck, 1991). Approximately 20 - 30 minutes were required to complete the entire package.

Personal Information Questionnaire (PIQ)

The PIQ is a self-report questionnaire specifically designed for the present study. The first section of the PIQ contained questions about age, gender, education level, current occupation, partying frequency and raving frequency. The next section required the participant to report their drug use history. Seven questions asked for information concerning Ecstasy use (only to be filled out by Ecstasy users). The last section contained five questions assessing alcohol use. The PIQ takes less than five minutes to complete.

Beck Depression Inventory (Second Edition) (BDI-II)

The BDI-II (Beck et al., 1996) is a unidimensional, self-report measure specifically designed to evaluate depression. The content covers the criteria for a Depressive Disorder in the Diagnostic and Statistical Manual of the American Psychiatric Association (1994). The BDI-II consists of 21 items with four possible responses; the individual is instructed to pick the response option that best describes the way they feel today. The time required to complete the inventory varies, but is usually 5 to 10 minutes. The BDI-II is scored by summing the responses given for each of the 21 questions. Higher scores indicate higher levels of depression. Scores of less than 9 are considered within the normal range, whereas those over 16 are indicative of clinical depression. Reliability and validity studies indicate that the BDI-II is a useful measure for assessing depression (Brown, Schulberg & Madonia, 1995; Dozois, Dobson & Ahnberg, 1998). The BDI-II was selected for the current study because previous research (Curran & Travill, 1997) has detected differences between Ecstasy users and controls on the BDI.

Impulsiveness, Venturesomeness and Empathy Scale (IVE)

The IVE (Eysenck & Eysenck, 1991) is a personality test yielding three independent scores on impulsiveness, venturesomeness and empathy. The test is comprised of 54 items, each requiring a dichotomous response (yes or no). The IVE takes approximately 10 to 15 minutes to complete. The scores range from 0 – 19 for impulsiveness and empathy, and 0 – 16 for venturesomeness, with high scores indicating elevated levels of these personality traits. The IVE was selected for the present study because it had differentiated Ecstasy users from non-users on impulsivity in earlier investigations (Callow, 1996; Morgan, 1998; Parrott et al., 2000).

Procedure

The participants were recruited from two raves and a nightclub in Fortitude Valley, Brisbane. The data were collected from three events. Participants were recruited at two raves, “System Six” (20th September, 2000) and “Creation” (29th September, 2000), which were both held at the Arena Entertainment Centre in Fortitude Valley. The Arena is the only venue in the Gold Coast and Brisbane area that hosts large-scale dance parties. “System Six” is a regular rave, held monthly at the Arena, and “Creation” was probably the second largest rave held at the Arena in 2000. The third night of recruitment was “Gatecrasher” (21st October, 2000), which was hosted by the nightclub Technomad in Fortitude Valley. “Gatecrasher” originated in Europe and is now a global sound system that is set up in different venues around the world. These three events were chosen because at these dance parties it was expected that there would be a high prevalence of Ecstasy use.

At 5am, when these events finished, potential participants were approached at the exit. They were asked if they were willing to participate in the study, and if they agreed they were provided the questionnaire packet with the instruction to complete it two days later. The anonymity of the participants was a very important issue in this study, as the participants would be providing personal information admitting that they had consumed an illegal substance or substances. Therefore, to ensure anonymity, the prospective participants were clearly informed not to put their name on any of the questionnaires. They were asked to return the completed questionnaires in the provided pre-paid addressed envelope. The returned packages were received by the School of Humanities at

Bond University. Over the three mornings, 300 packages were handed out, resulting in a return rate of 25.3%, which was considered extremely successful.

Results

Drug History

Independent sample t-tests were conducted to compare drug use histories of Ecstasy users and non-user controls. No significant differences were found between the two groups on heroin use, other opiate use, solvent and inhalant use or cigarette smoking. The drug histories of the two groups were significantly different in terms of alcohol use, cannabis use, amphetamine use, cocaine use, LSD/hallucinogen use, and (of course) Ecstasy use. Controls reported higher alcohol consumption than Ecstasy users, $t(72) = 2.04, p < .05$. By contrast, Ecstasy users reported higher use of illicit substances than controls, with differences on cannabis use, $t(72) = 3.62, p < .01$; amphetamine use, $t(72) = 5.94, p < .01$; cocaine use, $t(72) = 3.53, p < .01$; use of LSD and other hallucinogens, $t(72) = 3.63, p < .01$; and Ecstasy use, $t(72) = 12.09, p < .0001$.

Ecstasy Use

Among the 43 participants in the Ecstasy user group, the average self-reported number of days since the last consumption of Ecstasy was 2.19 days, as seven participants filled out the questionnaires 3 or 4 days after the event rather than 2 days after as instructed. All controls completed the questionnaires 2 days after the event, as per instructions. The average amount of tablets taken by Ecstasy users at the rave or dance party was 1.30 ($SD = 1.77$), with a range of half a tablet to four tablets. The usual amount of tablets taken was similar ($M = 1.33, SD = 0.47$). Of the Ecstasy users 47% reported taking Ecstasy weekly or fortnightly, 33% took it monthly or every two months,

and the remaining 21% took Ecstasy every three to six months. The sample had been using Ecstasy for an average of 2.88 years ($SD = 3.87$), with a range of 3 months to 11 years. Total estimated lifetime number of tablets taken ranged from 2 tablets to over 200 tablets ($M = 43.2$ tablets).

Alcohol Use at Venue

A one-way ANOVA was conducted to assess differences in alcohol use at the raves or dance party between Ecstasy users and controls. The groups were significantly different with regard to the number of drinks consumed at the rave or dance party. Control participants consumed significantly more alcoholic drinks than participants who took Ecstasy, $t(70) = 2.55, p < .05$. The control group reported that they consumed an average of 15 standard drinks at the events, whereas those who took Ecstasy reported that they consumed an average of 5 standard drinks at the same events.

Mood

Scores on the BDI-II were significantly different between the two groups, $t(72) = 2.02, p < .05$. Ecstasy users reported significantly more depressed mood levels as indicated by higher BDI-II scores ($M = 9.7, SD = 7.05$) than controls ($M = 6.8, SD = 5.2$). However, correlational analyses showed that in Ecstasy users, neither the amount of Ecstasy taken at the venue nor estimated lifetime Ecstasy consumption were significantly related to mood ratings. Users with the highest level of lifetime Ecstasy exposure had the lowest depression scores, although this trend did not approach significance (see Table 1).

Impulsivity

An independent samples t-test indicated that the IVE subscore for trait impulsiveness did not significantly differ between Ecstasy users ($M = 9.42, SD = 4.49$)

and controls ($M = 10.42$, $SD = 4.53$), $t(72) = 0.96$, *ns*. Correlational analyses showed that neither the amount of Ecstasy taken at the venue nor estimated lifetime Ecstasy consumption were significantly related to impulsivity scores, although as with the depression scores there was a nonsignificant trend such that the lowest trait impulsivity scores were obtained from the heaviest Ecstasy users (see Table 1).

Table 1. Lifetime Number of Ecstasy Tablets in Relation to Mood and Impulsivity.

Lifetime number of Ecstasy tablets	N	Depression Scores (BDI-II)	Impulsivity Scores (IVE)
15 or less	14	8.93 (7.68)	9.64 (4.09)
16 – 30	14	12.86 (7.38)	10.50 (4.75)
Over 30	13	7.54 (5.56)	7.08 (3.75)

Discussion

The present study investigated possible residual effects of Ecstasy on mood and impulsivity in recreational Ecstasy users. Results indicated that recreational Ecstasy use at a rave or dance venue was associated with a depressed mood two days after consuming the drug, in comparison to non-Ecstasy using controls who attended the same events and reported normal moods two days later. There was no difference between Ecstasy users and controls on impulsivity, and no dose-response relationships were indicated between level of Ecstasy use and depression or impulsivity scores. Among Ecstasy users the heaviest users had the lowest depression and impulsivity scores, although this apparent trend did not approach significance.

The present results supported the prediction that BDI-II depression scores would be higher in recreational Ecstasy users than controls in the week after Ecstasy use. This

finding is consistent with previous research (Curran & Travill, 1997; Parrott & Lasky, 1998) and anecdotal reports that Ecstasy can lead to depressive symptoms in the week after it is taken (Saunders, 1995). Previous research suggests that the cause of this lowering of mood after the Ecstasy “high” subsides could be short term reversible serotonin depletion following the acute elevation of serotonin release induced by MDMA (Gerra et al., 1998). Alarmingly, out of the 43 Ecstasy users in this study, 10 (23%) scored over 16 on the BDI-II, indicating clinical depression, whereas only 2 (6%) controls scored within this range. In the similar study by Curran and Travill (1997), some of their Ecstasy participants also scored within the clinically depressed range.

Although previous research cited above has suggested that MDMA-induced neurochemical changes may explain the lowering of mood two days following Ecstasy use, other factors stemming from the self-selected nature of the samples might alternatively account for this finding. The Ecstasy users in the present study reported previous use of other illicit substances at higher levels than the Ecstasy-naive controls, in line with previous research indicating that Ecstasy users tend to be extensive polydrug users (Topp et al., 1999). Thus the mood difference observed in the present study could conceivably be attributable to the use of other substances by the Ecstasy user group. Another possibility is that the observed difference in mood scores reflected trait differences between Ecstasy users and non-users. On average, the Ecstasy group may have been more prone to depression or dysthymia than the control group, whether or not they took Ecstasy on the previous weekend. If so, Ecstasy or other drug use may represent a means of self-medication (Boot, McGregor & Hall, 2000). However, the

absence of any relationship between total lifetime use of Ecstasy and depression scores in the present study is inconsistent with the self-medication interpretation.

Other factors should also be considered. MDMA is said to produce a 'high' of happiness and well-being that may leave the user feeling 'low' by comparison in the following week (Martin, 1999). An Ecstasy user stated: "By dancing all night on E, a feeling of total bliss and utter fulfilment is achieved, and of course the downside to this is that nothing else beats that feeling, thus reality can seem boring" (Saunders, 1995, p. 85). Further, a night of raving has somatic and physiological consequences in the following week. Going to raves involves sleep deprivation and exhaustive dancing that may lead to overheating and dehydration which are exacerbated by MDMA (Wijngaart et al., 1999). Therefore the apparent residual effect on mood indicated in the present study may have resulted from a combination of the rave situation and MDMA, rather than MDMA alone. An additional consideration is the possibility that at least some Ecstasy users took a different drug that was misrepresented as MDMA on the night of the rave or dance event. However, a recent analysis of blood and urine samples from rave party attendees in Australia revealed that all participants who said they had taken "Ecstasy" showed high levels of MDMA (Irvine et al., 2003), and a recent review (Parrott, 2004) concluded that illicit samples of Ecstasy now contain effective doses of MDMA in 90-100% of cases. Thus the present sample likely contained a significant proportion of Ecstasy users who had actually taken MDMA at the events. Another possible interpretation of the present findings is that widely disseminated publicity about supposed adverse aftereffects of Ecstasy use on mood may have biased the mood ratings of Ecstasy users.

Present results did not support the prediction that Ecstasy users would be more impulsive than controls. This finding is inconsistent with a number of previous studies (Callow, 1996; Halpern et al., 2004; Morgan, 1998; Parrott et al., 2000). The higher impulsivity of Ecstasy users indicated in such studies has often been attributed to enduring neurotoxic effects of MDMA on the serotonin system, as inherent deficits in serotonergic system functioning have been associated with impulsive behaviour (Linnoila et al., 1993; Soubrie, 1986; Virkkunen & Linnoila, 1993). However, findings in Ecstasy users have been inconsistent in this regard; for example, McCann et al. (1994) reported that Ecstasy users were less impulsive than non-users. Present results likewise indicated that Ecstasy use was not associated with increased impulsivity; indeed, the trend was for the heaviest users to have the lowest impulsivity scores. Perhaps any residual or chronic MDMA-induced impairments of the serotonin system do not affect behaviour in such a way as to make Ecstasy users resemble those with endogenous serotonergic deficits and impulsivity-related disorders (McCann et al., 1994), or alternatively, perhaps the doses of MDMA taken by most users are insufficient to cause significant serotonergic depletion or neurotoxic damage (Boot et al., 2000). Elevated impulsivity was recently reported in heavy Ecstasy users (who took Ecstasy more than 50 times, a more stringent criterion than in the present study) but not moderate (20-50 times) users (Halpern et al., 2004), however, a variety of evidence suggests such differences may reflect pre-drug traits that predispose to heavy drug use rather than neurotoxic effects of high exposure to MDMA (Lyvers & Hasking, 2004). The present study did not find any relationships between self-estimated lifetime Ecstasy use and mood or impulsivity. This contradicts some previous reports in which heavier lifetime consumption of Ecstasy was associated with elevated

levels of impulsivity (Halpern et al., 2004; Soubrie, 1986) or depression (Curran & Travill, 1997), although such relationships have been inconsistently observed (Cole & Sumnall, 2003).

The present study adds to other work suggesting a lowering of mood in the week following Ecstasy use at rave or dance venues. Of considerable concern is the present finding that 10 Ecstasy users were clinically depressed as indicated by their BDI-II scores. Such disruptions in mood may interfere with various aspects of the individual's life, including work-related issues and interpersonal relationships (Solowij et al., 1992; Wijnnaart et al., 1999). Depressed mood may also promote continued drug use. Further work is clearly needed to elucidate the nature and consequences of the "midweek blues" that seems to follow Ecstasy use at weekend rave or dance events.

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