Author(s): K. Soar, A. Parrott and J. Turner
Article Title: Attributions for psychobiological changes in ecstasy/MDMA and other polydrug users
Year of publication: 2009
Citation: Soar, K., Parrott, A. and Turner, J. (2009) 'Attributions for psychobiological changes in ecstasy/MDMA and other polydrug users'. *Journal of Psychopharmacology,* 23(7), pp. 745-758.

Link to published version:
http://dx.doi.org/10.1177/0269881108092594

INTRODUCTION

Recreational ecstasy (MDMA) use has been associated with a number of psychiatric symptoms and psychobiological problems (Milani et al, 2000; MacInnes et al, 2001; Parrott et al, 2001; Verheyden et al, 2003; Soar et al, 2006; Rodgers et al, 2006). A range of measures have been used to record such psychobiological problems, including clinical measures such as the Symptom Checklist-90 (Parrott, Sisk and Turner, 2000; Parrott et al, 2001; Dugherio et al, 2001;Milani et al 2004), the Symptom Checklist-90-Revised (Daumann et al, 2001 & 2004; Morgan et al, 2002; Thomasius et al, 2006), and specific measures of depression (MacInnes et al, 2001; de Win et al, 2006; Lamers et al, 2006) and anxiety (Lamers et al, 2006). These studies have shown that ecstasy users often demonstrate higher levels of psychopathology than non-ecstasy user control groups. However, only a limited number of studies have addressed what problems ecstasy users specifically *attribute* 'off-drug' to their current and past ecstasy use. Cohen (1995) showed that a number of ecstasy users reported both psychological and physical long term recurring effects which they attributed to their ecstasy use, including depersonalisation, insomnia and depression. Parrott et al (2002) also reported ecstasy-attributed problems as reported by novice (1-9), moderate (10-99) and heavy (+100) ecstasy users, including depression, memory problems, mood fluctuation, poor concentration, infections, tremors/twitches and weight loss, which were all shown to be significantly associated with the extent of ecstasy use. Rodgers et al (2006) reported a variety of 'off-drug' problems attributed to ecstasy in 209 ecstasy users, similar to those reported by Parrott et al (2002), and confirmed the strong association with lifetime Ecstasy/MDMA use. Rodgers et al (2006) also reported that users attributed a number of 'off-drug' perceived positive effects to their ecstasy consumption; including 'a changed outlook on life', 'understanding of self', and improved relationships, sociability, psychological functioning

and healthiness. However, none of these studies explored the role of other drugs, combinations of ecstasy with other drugs, or related non-drug factors, in the attributions made by ecstasy users.

Epidemiological studies show that individuals who regularly take ecstasy are also likely to be polydrug users (Webb et al, 1996; Pederson & Skrondal, 1999; Topp et al, 1999; Sherlock and Connor, 1999; Winstock et al, 2001; Strote et al, 2002; Arria et al, 2002; Scholey et al, 2004; Sumnall et al, 2004; Hopper et al, 2006). The most commonly reported co-used substances are tobacco, alcohol, cannabis, amphetamine and cocaine (Sherlock and Connor, 1999; Gouzoulis-Mayfrank and Daumann, 2006), although increasing use of ecstasy appears to also be associated with more widespread and heavier use of other stimulants and hallucinogens (Scholey et al, 2004). These drugs have also been linked with negative psychopathological profiles (Mass et al, 2001; Lavik & Onstad, 1986). As such, it's clear that polydrug use is an important potential influence for the psychobiological consequences of ecstasy/MDMA consumption (Parrott, 2006). Indeed, Parrott et al (2001) found that the heavier the polydrug use alongside ecstasy the higher the level of self-reported psychological symptoms. Other studies have also shown that elevated psychopathology in ecstasy users appears to be associated more with polydrug use (Medina and Shear, 2007), and in some cases specifically cannabis rather than ecstasy (Daumann et al, 2001; Morgan et al., 2002; Rosier and Sahakian, 2004; Daumann et al, 2004). A possible combination effect of ecstasy and cannabis use is also supported by recent findings from Milani et al (2005), who reported that heavy cannabis use appeared to exacerbate psychobiological problems in ecstasy users, and Lamers et al (2006) who found that individuals who used both ecstasy and cannabis reported more symptoms of anxiety and depression than non-drug users and cannabis only users. In a review of this topic, Parrott (2006) showed that the deficits of Ecstasy/MDMA users generally remained significant after controlling for these other psychoactive drugs, although it was emphasised that these other drugs would also be having important contributory effects.

The present study continues this exploration of chronic 'off-drug' experiences, using a large scale survey which sought to determine which drugs were associated with the long-term psychological and physical effects reported by some ecstasy-polydrug users. The volunteers were asked to indicate which drug or drug combinations, if any; they attributed to changes in their life experiences. These 'life experience' items were drawn from previous empirical and subjective literature into ecstasy/MDMA (Liechti et al 2000; Gamma et al, 2000; Cami et al, 2000; Liechti and Vollenweider, 2001; Cohen et al, 1995; Parrott et al, 2002). This novel manipulation then, tests the assumption that such changes result from ecstasy use, over and above the effects of other substances, by transposing these positive and negative 'symptoms' into questions and exploring the perceptions and attributions to different drugs amongst polysubstance users themselves.

Another aim was to investigate possible differences in drug-attributions between ecstasy users that did not report problems associated with their ecstasy use (non-problematic users), compared with ecstasy users who did reported problems with their ecstasy use (problematic users). Fox et al (2001) and Soar et al (2006) have previously compared 'problematic' and 'non-problematic' ecstasy users, and found differences in the perceived psychological problems attributed to their ecstasy consumption; and to a degree such differences have been accounted for by premorbid characteristics and patterns of ecstasy use. However, the role of other polydrug use has not previously been addressed in these two sub-groups.

METHOD

Participants

Participants were recruited through a number of techniques, including recruitment notices throughout the University of East London's e-mail system, posters around the University of East London and various clubs throughout London, and via an advertisement in the 'Big Issue' magazine The call for participants asked for any ecstasy and/or other drug users (including alcohol and nicotine) interested in contributing to psychological research to contact us or visit our website. The exclusion criteria were: under the age of 18, currently taking any psychotropic medication, epilepsy or any other form of brain injury.

Two-hundred and eighty-eight volunteers participated in the study: 111 (37 male, 74 female) participants who reported no past drug use, other than alcohol and nicotine; 62 (27 male, 35 female) polydrug users who had no history of ecstasy use but otherwise had used other illicit drugs; 62 (33 male, 29 female) 'non-problematic' ecstasy users, who reported ecstasy and other drug use but did not report problems from their past ecstasy use; and 53 (25 male, 28 female) 'problematic' ecstasy users, who reported ecstasy and other polydrug use and also indicated that they had experienced problems which they attributed to ecstasy use. All participants were allocated to these groups using a *post hoc* method: problematic ecstasy users were distinguished from non-problematic users by answering 'yes' to the question, 'Have you experienced any problems, which you attribute to your ecstasy use?' All participants gave written informed consent and The University of East London ethics committee approved the study.

Assessment Measures

Each volunteer completed a questionnaire using either a hard copy (n= 46) or one accessed and submitted on-line (n=242) via http://homepages.uel.ac.uk/K.Soar/ecstasy_qa.htm (part of the University of East London's web-site).

Health & Drug Use Questionnaire

This questionnaire (used previously in Soar et al, 2006), consisted of questions concerning personal history of participants own, and their immediate family's, psychiatric history. Questions pertaining to past drug history were those that make up the UEL drug use questionnaire (Parrott, Sisk and Turner, 2000), Ecstasy users were required to provide further information concerning patterns of ecstasy use: including information on the duration of ecstasy use, the last time taken, the average number of ecstasy tablets consumed in one occasion and the largest number consumed in one occasion and an estimation of their lifetime consumption . This was followed by the question which allowed *post hoc* group allocation to problematic and non-problematic ecstasy groups. Those ecstasy users that indicated they had or did attribute problems to ecstasy use were further asked whether any of these changes had led them to seek help and/or advice from a health professional or organisation, and to indicate which particular service (e.g. GP, Clinical psychologist, psychiatrist, drugs clinic/services or counselling). Again all of these questions have previously been utilised to ascertain patterns of ecstasy use and indication of problems in ecstasy users (e.g. Soar et al, 2006).

Life changes Questionnaire

This questionnaire was designed specifically for this study, it required all participants to indicate whether or not they had experienced a list of 7 positive and 21 negative changes in their life

experiences, when *not* under the influence of drugs or alcohol. These life experiences were in fact psychological and physical effects, which have previously been shown to be associated with ecstasy (MDMA). The items were drawn from a review of the empirical and subjective effects associated with ecstasy use (Liechti et al 2000; Gamma et al, 2000; Cami et al, 2000; Liechti & Vollenweider, 2001; Cohen et al, 1995; Parrott et al, 2002). However, wording of the questions did not allude specifically to this connection with ecstasy/MDMA: *"Below are a list of positive and negative life experiences, please indicate whether you have experience any of these (when* ***not*** *under the influence of drugs or alcohol) and what you attribute this change to the most by circling the appropriate statements"*. This allowed for exploration of whether these effects are reported by all participants, regardless of their ecstasy use, and whether these so called 'ecstasy effects' are in fact effects associated or attributed to other, different drugs, amongst those polydrug users. The imbalance in the number of positive and negative items used reflects current bias in the research literature on the investigation into the negative effects of ecstasy/MDMA. Participants were shown a list of the 28 positive and negative (life experience/ecstasy effects) items followed by 8 options to circle; 'other non-drug factor', 'ecstasy', 'amphetamine', 'cocaine', 'LSD', 'Cannabis', 'alcohol' or 'no change experienced'. Those specific drug options were chosen because they are the most common drugs used by recreational ecstasy polydrug users and also in combination with ecstasy (e.g. Scholey et al, 2004; Gouzouluis-Mayfrank and Daumann, 2006). Cronbach's' alpha reliability analyses for the scale (all 28 items) indicates good reliability: $\alpha = 0.90$.

Statistical Analysis

Data analysis was conducted using SPSS 10. One-way ANOVAs were performed on the demographic data to assess whether there were any group differences between the alcohol/nicotine group, polydrug controls, non-problematic and problematic ecstasy users. Where there were violations of homogeneity of variance (e.g. age and rating of health) the Kruskall Wallis test was employed. *Post hoc* pair-wise comparisons between groups were conducted using the Tukey's HSD range statistic and Mann-Whitney test for the non-parametric equivalent, with the error rate set at 0.017 to reduce the risk of type 1 errors**.** Chi-squared tests were used to investigate any significant group differences with questions regarding gender, ethnicity, reported psychiatric history and family psychiatric history.

Drug use data violated the assumption of homogeneity of variance, despite attempts at transforming the data. Therefore Kruskall Wallis tests were employed. The independent samples *t*-test was used to assess differences in patterns of ecstasy use between the two ecstasy using groups.

Data concerning the positive and negative changes to life experiences and which, if any, drugs they attributed these changes to, are reported as percentages. It was deemed inappropriate to conduct detailed inferential analyses on all of this data for a number of reasons. The first was that levels of drug use differed considerably across all four drug using groups. Secondly, respondents sometimes indicated more than one drug for each dimension on the questionnaire, yet it was difficult to establish whether they were referring to polydrug use as contributing to this change or whether individual drugs *per se* contributed to this change. Thirdly, not all cells were independent. Finally, if a chi squared test was conducted the expected frequency would be less than 5 on more than 20% of cases; therefore it would not have been statistically viable. However, data concerning the number of respondents, in each of the four groups, who indicated they had

experienced a change were analysed using a 4 x 2 Chi Squared test. Separate 2 x 2 Chi Square tests were used to establish where, between the four groups, any statistically significant differences lay. A significance level of 0.008 was used, in order to limit the possibilities of type 1 errors. For those respondents in the drug using groups who did indicate a change attributable to drug use, a 3 x 2 Chi Squared test was utilised to establish whether there were any significant differences between the number of respondents in each group who indicated more than one drug as indicative of positive and negative changes. Separate 2 x 2 chi square tests were used to establish which groups differed with the significance level set at 0.02 to reduce possible type 1 errors. The effect size (Cohen's W) and post hoc power calculations of the main group Chi square analyses (calculated using G*Power 3) are also given in tables 3 and 4, where appropriate. The standard conventions for W are 0.1, 0.3 and 0.5 for small, medium and large effect sizes, respectively (Cohen, 1988).

RESULTS

Group characteristics and drug data

Table 1 show the demographic data for the participants and patterns of drug use and table 2 indicate the number of participants, by group, who indicated previous individual and family psychiatric problems (data previously reported for these participants in Soar et al, 2006). There were no significant group differences for gender or health. However, there was a significant group effect of age [$\chi^2(3) = 19.51$, $p<0.001$], as non-problematic ecstasy users were significantly older than alcohol/nicotine group ($p=<0.001$). There was a significant difference in reported psychiatric history ($\chi^2(3) = 30.71$, $p<0.001$) and family psychiatric history ($\chi^2(3) = 18.84$,

$p<0.001$), with a greater number of problematic ecstasy users reporting a psychiatric history compared to controls and ecstasy users. There was also a significant difference in ethnicity between groups ($\chi^2(12) = 45.78$, $p<0.001$), with alcohol/nicotine participants showing greater ethnic diversity than non-problematic ecstasy and problematic ecstasy users.

[table 1 & 2]

There were significant group differences on most levels of reported illegal drug consumption: amphetamine, cocaine, crack, LSD, magic mushrooms, poppers, ketamine and current cannabis use. Specifically, polydrug controls reported using significantly less amphetamine, cocaine, LSD, magic mushrooms, poppers, ketamine and current cannabis use, compared to non-problematic ecstasy and problematic ecstasy users; and significantly less crack use compared to problematic ecstasy users. Given that this group of users reported low use of drugs with the exception of cannabis, it was deemed appropriate to refer to this group as cannabis using controls rather than polydrug controls from here on. Non-problematic ecstasy and problematic ecstasy users reported similar consumption of illegal drugs, with the exception of LSD and magic mushrooms, where the problematic ecstasy group reported a significantly greater consumption of both drugs.

The alcohol/nicotine group reported significantly less tobacco and alcohol use compared to cannabis, non-problematic ecstasy and problematic ecstasy users. Cannabis controls also reported significantly less tobacco use compared to non-problematic ecstasy and problematic ecstasy users, as well as significantly less alcohol use compared to non-problematic ecstasy users.

Patterns of ecstasy use differed between the two ecstasy using groups. Problematic ecstasy users reported significantly higher lifetime consumption levels of ecstasy [$t(113) = -2.31$, $p = 0.025$] , average dosage levels [$t(109) = -3.09$, $p = 0.003$] and maximum dosage levels [$t(109) = -2.90$, $p = 0.005$] compared to non-problematic ecstasy users. However, there were no significant differences in duration of ecstasy use and length of abstinence periods from ecstasy use between the two ecstasy using groups.

Problematic ecstasy users were also asked to indicate whether they had sought some form of help for their attributed problems. 32.1% (n = 17) reported that they had, the most common help sought was from a GP (26.4%). 11.3% sought help from a psychiatrist and 9.4% sought help from a clinical psychologist or drugs service. The final 11.3% sought help from a variety of other organisations, which included counselling services.

Changes in Life Experiences Questionnaire

[table 3]

Table 2 shows the number and percentage of alcohol/nicotine users, cannabis controls, non-problematic and problematic ecstasy users who reported that they had experienced positive and negative life changes. There were highly significant differences between groups for all life changes. Post hoc comparisons are also indicated (table 3), with a significant lower number of people in the alcohol/nicotine group reporting experiencing a majority of the positive and negative changes compared to cannabis controls, non-problematic and problematic ecstasy user

groups. Cannabis users reported significantly less life experience changes compared to non-problematic and/or problematic ecstasy users in areas of spiritual enlightenment, enhanced sensations, obsessive thoughts, mood swings, depression, anxiety, paranoia, hallucinations, panic attacks, weight loss, sleep disruptions, but a greater number of cannabis using controls reported memory problems compared to both non-problematic and problematic ecstasy users. A significantly greater number of problematic ecstasy users reported changes in panic attacks, depression, paranoia and general illness, compared to non-problematic ecstasy users.

Changes in life experiences attributed to single versus multiple drug types

[table 4]

Chi squared results indicate that there were significant groups differences in the number of people who reported attributing life changes to more than one drug on a majority of life changes (table 4). Of those cannabis using controls who did indicate life changes attributable to drugs, they were significantly more likely to attribute these changes to just one drug rather than a combination of drugs, compared to the non-problematic and problematic ecstasy users. This finding was relatively consistent across positive and negative life changes, except for spiritual enlightenment, confidence loss, backache and sexual problems. In addition, compared to non-problematic ecstasy users, a significantly higher number of problematic ecstasy users attributed more than one drug to increased empathy, decreased fear, obsessive thoughts, aggression, anxiety, paranoia, hallucinations, sexual problems, and general illness, loss of organisational skills, memory loss and concentration loss.

Specific Drugs and Attributions to Positive Life Experience Changes

In attempting to establish which, if any, specific drugs were more likely to be associated by participants as being linked to or causing specific changes in behaviour/life experience, inferences could only be made by comparing percentages, for reasons stated earlier (tables 5-8). Improved social/interpersonal functioning was relatively strongly attributed to alcohol compared to any other drug across all four groups, with 18% of alcohol/nicotine users, 45.2% cannabis controls, 43.5% non-problematic ecstasy users and 28.3% problematic ecstasy users attributing this change to alcohol. However, amongst non-problematic ecstasy users, ecstasy (35.5%) and cocaine (33.9%) was also reported as having played a strong part, whilst amongst problematic ecstasy users this life change was more often attributed to ecstasy than alcohol (45.3% vs. 28.3% respectively). A decrease in fear was also attributed mostly to alcohol compared to any other drug, amongst drug naïve (12.6%), cannabis controls (32.3%) and non-problematic ecstasy user (32.3%) groups.

Increased feelings of well-being were also attributed to alcohol amongst polydrug controls (21%) and non-problematic ecstasy users (25.8%), but also to cannabis (24.2%) in the cannabis using controls, whilst amongst non-problematic ecstasy users, ecstasy (25.8%) and cocaine (27.4%) were strongly implicated. Ecstasy was the strongest drug implicated (35.8%) in feelings of well-being with problematic ecstasy users.

Cannabis was reported as the reason behind enhanced sensations, by 22.6% of cannabis using controls, yet ecstasy appeared to be the drug that non-problematic (54.8%) and problematic ecstasy users (56.6%) attributed this change to the most, with LSD, cocaine and cannabis also being implicated in these two ecstasy using groups. Ecstasy use was also commonly linked to

changes in spiritual enlightenment in both of these groups (27.4% of non-problematic and 30.2% problematic ecstasy users), although non-problematic ecstasy users reported LSD to have contributed equally to this change. As expected, increased empathy was attributed to ecstasy more than any other drug amongst non-problematic and problematic ecstasy users (45.2% and 45.3% respectively), as was a decrease in defensiveness amongst problematic ecstasy users (35.8%).

Specific Drugs and Attributions to Negative Life Experience Changes

Aggression appeared to be strongly associated with alcohol compared to any other drug and across all groups, with 24.2% of cannabis controls, 32.3% ecstasy users and 26.4% problematic users attributing this change to alcohol. Paranoia was most strongly associated with cannabis, compared to other drugs and across groups, with 21% of cannabis controls, 25.8% ecstasy users and 49.1% problematic ecstasy users implicating cannabis in this change. However, problematic ecstasy users also attributed paranoia quite highly to ecstasy (34%) and amphetamine (30.2%) use.

Cannabis use also appeared to be a strong factor compared to any other drug for motivational problems and loss of sociability in both non-problematic ecstasy (30.6% and 22.6% respectively) and problematic ecstasy users (32.1% and 39.6%). Cannabis was also implicated in perceptions of concentration loss amongst problematic ecstasy users (24.5%) and also with memory loss amongst non-problematic ecstasy users (27.4%) compared to a low implication of ecstasy attributed to memory loss in this non-problematic and problematic ecstasy users (only 4.8% and 13.2% respectively).

Hallucinations were mainly reported by problematic ecstasy users but were equally attributed to ecstasy and LSD use (24.5%). This is probably because this group reported significantly greater consumption levels of both ecstasy and LSD compared to the other drug using groups.

Ecstasy was a very strong attributional factor linked negatively perceived changes in depression (62.3%), anxiety (37.7%), panic attacks (34%), general illness (39.6%) and weight loss (49.1%) amongst problematic ecstasy users. Amongst this group, ecstasy was also implicated in obsessive thoughts, alongside cannabis use (30.2%). Whilst in the non-problematic user group, far fewer participants linked their ecstasy use to these negative symptoms. Mood swings were also strongly attributed to ecstasy, amongst ecstasy and problematic ecstasy users (25.8% and 54.7% respectively), but so too were the stimulants, cocaine and amphetamine. Similarly both ecstasy using groups reported similar drug attributions with sleep problems.

DISCUSSION

Parrott et al (2001) and Milani et al (2005) showed that psychiatric symptoms and psychobiological problems were associated not only with ecstasy/MDMA use, but also with recreational polydrug use. The current exploratory survey investigated the issue of polydrug use with regard to long term 'off-drug' psychological and physical effects reported by recreational drug users. It sought to determine which drugs, if any, were associated with the long-term effects reported by some ecstasy-polydrug users and whether problematic and non-problematic ecstasy users differed with respect to what problems they attributed to particular drugs or drug combinations.

The study demonstrated that polydrug use does play a role in the effects commonly associated with ecstasy use, referred to here as positive and negative life changes. A significantly greater number of cannabis controls and ecstasy users reported life changes compared to non-drug users in a number of positive and negative areas, and further still attributing these more to drug use than 'other factors', suggesting that polydrug use certainly plays a role in attributions related to changes in life experiences. Amongst the drug using groups (cannabis and ecstasy user groups), the ecstasy users reported the greatest number of changes and in some areas i.e. panic attacks, depression, paranoia and general illness, problematic ecstasy users reported more changes compared to non-problematic ecstasy users. The fact that fewer cannabis using controls reported changes compared to ecstasy users could reflect that ecstasy rather than polydrug use is more associated with these effects, however, levels of polydrug use are significantly higher in both ecstasy using groups compared to the cannabis controls. This strongly supports previous studies suggesting that the heavier the ecstasy use, the heavier the polydrug use (Scholey et al, 2004) and as such, these effects can not solely be attributed to ecstasy, based on these group differences in life changes.

Whether drug user's attributed changes to a single drug or a number of drugs was also explored. Cannabis using controls who reported changes, and attributed these to drug use, tended to attribute the change to just the one drug, which tended to be cannabis or alcohol, rather than both. This isn't surprising given the limited use of other drugs in this group (see table 1). In comparison, the ecstasy using groups tended to report a combination of drugs as influencing the reported changes (both positive and negative), more so for the problematic ecstasy users. Of the drugs reported ecstasy did appear to play a strong attributional role, especially for problematic ecstasy users with regard to depression, anxiety, panic attacks, general illness and mood swings.

However, this could simply be due to the nature of the study, and potential priming in these participants from completion of earlier questions on the patterns of ecstasy use and whether they indicated problems associated with their past use, specifically for problematic ecstasy users. Whilst this is a possibility to some extent, the strong attributional role of ecstasy, particularly in these areas is consistent to previous research (Parrott et al, 2002; Rodgers et al, 2006). Whilst ecstasy is a strong attributional role for a lot of the changes reported by the ecstasy users, what is interesting is that when investigated further, especially amongst the problematic ecstasy users, it is not the only drug which plays a role in reported problems, rather a range of drugs are strongly implicated. These other drugs include alcohol, amphetamine and cocaine and especially cannabis, which participants associated with negative changes such as paranoia, memory loss, concentration loss, motivational problems and obsessive thoughts. The role of these and other drugs in ecstasy-attributed effects was not covered by Parrott et al (2004) or Rodgers et al (2006), but is consistent with the findings that elevated psychopathology in ecstasy users is associated with polydrug use (Medina and Shear, 2007), and in some cases specifically cannabis (Daumann et al, 2001; Morgan et al, 2002; Rosier & Sahakian, 2004; Daumann et al, 2004). Thus, data from the current study, taken together with these previous reports highlight the important possible confounding effects of polydrug use in research attempting to explore and characterise the extent and nature of MDMA/ecstasy-related effects.

As previously discussed there were differences in drug attributions between the ecstasy using groups (non-problematic and problematic). The fact that problematic ecstasy users reported more changes and attributed these more to ecstasy than other drugs, over and above non-problematic ecstasy users is not surprising given that these ecstasy users identify themselves as ‘having psychological problems’ which they attribute to past ecstasy use. It is possible that these problematic ecstasy users were experiencing these problems prior to their ecstasy use given that a

greater number of problematic ecstasy users reported psychiatric histories compared to non-problematic ecstasy users; an account previously acknowledged by the authors (Soar & Parrott, 2002; Soar et al, 2006). Suggesting that pre-existing problems could be the cause of the drug use rather than the consequence; this has previously been shown by Lieb et al (2002) who reported that in a majority of cases ecstasy and other drug use was actually secondary to the onset of psychological problems. However, more recently Alati et al (2008) have prospectively shown that the psychopathology, such as anxiety and depression, did not precede ecstasy use. Whether the problems reported by problematic ecstasy users within this current study preceded or followed ecstasy user, is impossible to conclude based on the retrospective nature of the current study.

It is possible that the reported differences between problematic and non-problematic ecstasy users could be accounted for by an attribution bias, and this could further explain why some ecstasy users do not report problems despite showing evidence that their psychological performance is impaired (Fox et al 2001). Attributional style itself can be influenced by medical and psychiatric history (Robbins and Kirmayer, 1991), and indeed individual psychological health at the time of reporting of symptoms/changes in experiences could influence questionnaire responses, especially if those problematic ecstasy users are still experiencing their reported problems. There is some indication of this from the psychopathological profiles of these problematic ecstasy users (reported in a previous paper, Soar et al, 2006), which indicated that scores on the Brief Symptom Inventory (BSI; Derogatis and Melisaratos, 1983) for these participants were significantly higher compared to the non-problematic ecstasy users, specifically on the somatisation, depression and anxiety subscales.

The current study has shown that other drug use is often attributed as being responsible for effects which have previously been described in numerous reports as being due to ecstasy/MDMA. This adds to the view that isolating the specific effects of ecstasy in recreational drug users is difficult, if not impossible. To complicate the issue further different patterns of polydrug use, consumed in combination with or directly following and/or preceding ecstasy use could influence the reporting of specific ecstasy-related effects and potential problems. Sumnall et al (2004) reported that 68% of the clubbers they interviewed regularly mixed a variety of drugs; the most popular combinations being cannabis, alcohol, ecstasy and amphetamines. Therefore, the complex interactions between drugs need to be considered, as well as their possible additive effects (Parrott, 2006; Gouzoulis-Mayfrank, 2006; Parrott et al, 2007). At present little is known of the psychopharmacological effects of combining drugs. Hernandez-Lopez et al (2002) reported that MDMA used in combination with alcohol induced longer lasting euphoria and well-being than MDMA or alcohol alone, whilst MDMA actually reversed the subjective sedation induced by alcohol; and Verheyden et al (2003) reported that participants who took cannabis, alcohol and cocaine in conjunction with ecstasy reported higher scores for acute positive effects of the drug, suggesting that the subjective pleasurable effects of these drugs are additive. Further still, they showed that users who had used cocaine in conjunction with their ecstasy use scored higher on the acute negative and positive effects compared to ecstasy users that had not used cocaine, whereas those who had used amphetamine and ecstasy together reported higher physical effects than those that had not. These findings may be of possible significance within the current study, and may explain why the ecstasy using groups within the current study reported ecstasy-related effects more to a combination of drugs than to single drug use.

As with the majority of research assessing the effects of recreational ecstasy polydrug use there are a number of methodological limitations that need to be acknowledged (for a detailed discussion see Curran, 2000). Profiles of individual's ecstasy and other drug use were based solely on self-report data with no biological assays to verify this data. Self-report data is not always reliable. These reports are unlikely to be wholly accurate and may often underestimate or overestimate drug consumption. They may also under- or overestimate their usage either because of fears about confidentiality or to heighten their 'street credibility'. Further still only lifetime estimations of other drug use were reported and similar questions akin to those asked of ecstasy users (e.g. average consumption and maximum consumption on each occasion and duration of usage) also need to be asked pertaining to patterns of other drug use, in order to establish specifically the contributing role, if any, of other drug use.

In this study there was also no objective assessment to show that participants were 'drug-free' at the time of completing the questionnaires. Even if they were drug free at the time of completion, there is the potential that rather than just reflecting on the long-term 'off-drug' effects, responses may have been affected by residual, sub-acute drug effects (Verheyden et al, 2003; Curran, et al, 2004).

The Life Experiences Questionnaire was developed from identifying the common psychological and physical effects associated with ecstasy use, from a review of the empirical and subjective reports on ecstasy users (Liechti et al 2000; Gamma et al, 2000; Cami et al, 2000; Liechti and Vollenweider, 2001; Cohen et al, 1995; Parrott et al, 2002). Labelling the questionnaire as 'Life Experiences', without reference to the identified items being known effects of ecstasy, allowed these effects to be explored in relation to other drug use, as well as ecstasy; thus, exploring the perceptions and attributions to different drugs amongst polysubstance users themselves. Given

that the Life Experiences questionnaire was devised specifically for this exploratory study, its validity and reliability needs to be fully determined in other samples of polysubstance users. However, support that this questionnaire does reliably detect life changes in ecstasy users and the distinction between problematic and non-problematic ecstasy users, comes from data on the psychopathological profiles of these users, reported in Soar et al (2006). However, the forced choice nature of the questionnaire limits participant responses and participant's interpretations of these questions could have also differed to that intended by the researchers. A semi-structured questionnaire or follow up interviews could provide more detailed information, and also explore other effects attributed to drug use rather just the psychological and physical effects of these substances, e.g. social aspects and lifestyle issues surrounding drug use, which too could influence the reporting of problems/changes in individuals lives.

The current study allocated ecstasy users to one of two groups (problematic and non-problematic ecstasy user) based on the response to a single question, 'Have you experienced any problems, which you attribute to your ecstasy use?' As pointed out by one of the reviewers, this question could be interpreted in a number of ways with participants attributing a wide range of problems including psychological, physical, social, economic etc. to their use of ecstasy. Whilst it is acknowledged by the authors that this is somewhat of a crude classification system, it replicates the method used by Fox et al (2001) who also asked participants to give some qualitative information regarding their problems. The common problems reported related predominantly to the psychological effects associated with the drug, such as low mood, depression and anxiety and cognitive difficulties. Additional evidence to suggest this single question has some validity also comes from the psychopathological profiles of these problematic ecstasy users compared to non-problematic ecstasy users, as measured by a standardised and validated measure – the BSI (Soar et al, 2006), suggesting that the problematic ecstasy users within this study were showing signs of

psychological problems over and above the non-problematic ecstasy and cannabis using controls. However, this still does not provide objective confirmation that the life changes reported by the drug users within this study have actually occurred. The significance of this objective confirmation of problems is somewhat trivial considering that individuals actually perceive themselves to have experienced certain changes, and in some these changes are perceived to be problematic to the extent that some of them are seeking help and advice from professional organisations. Taken together, this highlights that the individual's perception of their experiences and problems are important when addressing drug-attributed effects. However, there may also be some individuals that are displaying problems and through poor self-awareness and/or the lack of recognition and perception of these problems (Parrott et al, 2002; Sumnall et al, 2004), may not be reporting them or more importantly seeking help for them.

Overall, whether one can objectively confirm the effects related to drug use or not, the current study reported that both ecstasy using groups reported greater polydrug use than cannabis using controls and that they also attributed more life changes, both positive and negative to a range of drugs rather than specifically just ecstasy. This data supports the important role of polydrug use and attributions in ecstasy-related effects and as such future research into the psychological effects of ecstasy clearly should not underestimate the contribution of other drug use/polydrug use.

REFERENCES

Alati R, Kinner SA, Hayatbakhsh MR, Mamun AA, Najman JM, Williams GM. (2008): Pathways to ecstasy use in young adults: Anxiety, depression or behavioural deviance? Drug and Alcohol Dependence, 92:108-115.

Arria AM, Yacoubian GS, Fost E. (2002): Ecstasy use among club rave attendees. Arch Paediatric Adolescent Medicine, 156: 295-296.

Cami J, Farre M, Mas M, Roset PN, Pausevida 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(4): 455-466.

Cohen J (1988): Statistical power analysis for the behavioural sciences. 2nd Ed. Erlbaum, Hillsdale.

Croft RJ, Mackay AJ, Mills ATD, Gruzelier GH. (2001): The relative contributions of ecstasy and cannabis to cognitive impairment. Psychopharmacology, 153: 373-379.

Curran HV (2000): "Is MDMA (`Ecstasy') Neurotoxic in Humans? An Overview of Evidence and of Methodological Problems in Research". Neuropsychobiology, 42:34-41.

Curran VH, 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 (Berl), 173(3-4):425-33

Daumann J, Pelz S, Becker S, Tuchtenhagen F, Gouzoulis-Mayfrank E. (2001) Psychological profile of abstinent recreationl ecstasy (MDMA) users and significance of concomitant cannabis use. Human Psychopharmacology, 16:627-633.

Daumann J, Hensen G, Thimm B, Rexk M, Till B, Gouzoulis-Mayfrank E. (2004) Self-reported psychopathological symptoms in abstinent recreational ecstasy (MDMA) users are mainly associated with regular cannabis use: further evidence from a combined cross-sectional/longitudinal investigation. Psychopharmacology 180:607-611.

Derogatis LR, Melisaratos N. (1983) The Brief Symptom Inventory: an introductory report. Psychological Medicine, 13(3): 595-605.

Dughiero G, Schifano F, Forza G. (2001): Personality dimensions and psychopathological profiles of ecstasy users. Human Psychopharmacology, 16: 635-639.

Fox HC, Milani MR, Parrott AC, Turner JJD. (2001): Differences in premorbid adjustment between problematic and non-problematic ecstasy users. Canadian College of Neuropsychopharmacology (CCNP) Annual Meeting: 52 (abstract).

Gamma A, Buck A, Berthold, Vollenweider FX. (2000): 3,4-Methylenedioxymethamphetamine (MDMA) modulates cortical and limbic brain activity as measured by [$H_2{}^{15}O$]-PET in healthy humans. Neuropsychopharmacology, 23(4): 389-395.

Gouzoulis-Mayfrank E, Daumann J, Tuchtenhagen F, Pelz S, Becker S, Kunert HJ, Fimm B, Sass H. (2000): Impaired cognitive performance in drug free users of recreational ecstasy (MDMA). Journal of Neurological & Neurosurgical Psychiatry, 68: 719-725.

Gouzoulis-Mayfrank E, Daumann J (2006): The confounding problem of polydrug use in recreational ecstasy/MDMA users: a brief overview. Journal of Psychopharmacology, 20(2): 189-193.

Hopper JW, Si Z, Looby AR, Ryan ET, Penetar DM, Palmer CM, Lukas SE. (2006): Incidence and patterns of polydrug use and craving for ecstasy in regular ecstasy users: An ecological momentary assessment study. Drug and Alcohol Dependence, 85(3): 221-235

Lamers CTJ, Bechara A, Rizzo M, Ramaekers JG. (2006) Cognitive function and mood in MDMA/THC users, THC users and non-drug using controls. Journal of Psychopharmacology, 20(2): 302-311

Lavik NJ & Onstad S. (1986): Drug use and psychiatric symptoms in adolescence. Acta Psychiatrica Scandinavica, 73(4): 437-440.

Lieb R, Schuetz CG, Pfister H, von Sydow K, Wittchen HU. (2002) Mental disorders in ecstasy users: a prospective-longitudinal investigation, Drug and Alcohol Dependence, 68(2): 195-207

Liechti ME, Baumann C, Gamma A, Vollenweider FX. (2000a): Acute psychological effects of 3,4-Methylenedioxymethamphethamine (MDMA, “Ecstasy”) are attenuated by the serotonin uptake inhibitor citalopram. Neuropsychopharmacology, 22(5):513-521.

Liechti, ME, Gamma A, Vollenweider FX. (2001): Gender differences in the subjective effects of MDMA. Psychopharmacology, 154: 161-168.

Liechti ME, Saur MR, Gamma A, Hell D, Vollenweider FX. (2000b): Psychological and Physiological effects of MDMA ("ecstasy") after pre-treatment with the 5-HT2 antagonist ketanserin in healthy humans. Neuropsychopharmacology, 23(4):396-404.

Liechti ME, Vollenweider FX. (2001): Which neuroreceptors mediate the subjective effects of MDMA in humans? A summary of mechanistic studies. Human Psychopharmacology, 16:589-598.

MacInnes N, Handley SL, Harding GFA (2001) Former chronic methylenedioxymethamphetaine (MDMA or ecstasy) users report mild depressive symptoms. Journal of Psychopharmacology, 15(3): 181-186

Mass R, Bardong C, Kindl K, Dahome B. (2001): Relationship between cannabis use, schizotypal traits, and cognitive function in healthy subjects. Psychopathology, 34(4):209-214.

Medina KL, Shear PK (2007): Anxiety, depression and behavioural symptoms of executive dysfunction in ecstasy users: contributions of polydrug use. Drug and Alcohol Dependence, 87: 303-311

Milani R, Turner JJD, Parrott AC, Parmar R. (2000): Recreational drug use and psychobiological problems, collaborative UK/Italy study (5): ecstasy (MDMA) polydrug user findings. Journal of Psychopharmacology, 14(3): PA22 (abstract).

Milani RM, Parrott AC (2004): Psychological problems may be associated with ecstasy dependence rather than ecstasy lifetime dose. World Journal of Biological Psychiatry, 5:130

Milani RM, Parrott AC, Schifano F, Turner JJD (2005): Patterns of cannabis use in ecstasy polydrug users: moderate cannabis use may compensate for self-rated aggression and somatic symptoms. Human Psychopharmacology, 20:1-13.

Miller DB, O'Callaghan JP. (1994): Environment-, drug- and stress-induced alterations in body temperature affect the neurotoxicity of substituted amphetamines in the C57BL/6J mouse. Journal of Pharmacology and Experimental Therapeutics, 270:752-760.

O'Loinsigh ED, Kelly JP, O'Boyle KM. (2000): Co-administration of d-amphetamine alters the acute and long-term effects of 3,4-methylenedioxymethamphetamine in rats. British Journal of Pharmacology, 131: 154P.

Morgan MJ, McFie L, Fleetwood LH, Robinson JA. (2002): Ecstasy (MDMA): are the psychological problems associated with its use reversed by prolonged abstinence? Psychopharmacology, 159: 592-303.

Parrott AC, Milani RM, Gouzoulis-Mayfrank E, Daumann J (2007): Cannabis and Ecstasy/MDMA (3,4-methylenedioxymethamphetamine): an analysis of their neuropsychobiological interactions in recreational users. Journal Neural Transmission, 114: 959-968

Parrott AC, Milani RM, Parmar R, Turner JJD. (2001): Recreational ecstasy/MDMA and other drug users from the UK and Italy: psychiatric symptoms and psychobiological problems. Psychopharmacology, 159: 77-82.

Parrott AC, Sisk E, Turner JJD. (2000): Psychobiological problems in heavy 'ecstasy' (MDMA) polydrug users. Drug Alcohol Dependence, 60(1):105-110.

Parrott AC, Buchanan T, Scholey AB, Heffernan T, Ling J, Rodgers J. (2002): Ecstasy/MDMA attributed problems reported by novice, moderate and heavy recreational users. Human Psychopharmacology, 17: 309-312.

Parrott AC (2006): MDMA in humans: factors which affect the neuropsychobiological profiles of recreational ecstasy users, the integrative role of bioenergetic stress. Journal of Psychopharmacology, 20(2): 147-163

Pedersen W & Skrondal A. (1999): Ecstasy and new patterns of drug use: a normal population study. Addiction, 94(1), 1695-1706.

Reilly D, Didcott P, Swift W, Hall W. (1998) Long-term cannabis use: characteristics of users in an Australian rural area. Addiction, 93 (6): 837-846

Robbins JM, Kirmayer LJ. (1991): Attributions of common somatic symptoms. Psychological Medicine, 21: 1029-1045

Rodgers J, Buchanan T, Pearson C, Parrott AC, Long J, Heffernan T, Scholey AB. (2006): Differential experiences of psychobiological sequelae of ecstasy use: quantitative and qualitative data from an internet study. Journal of Psychopharmacology, 20(3): 437-447

Roiser JP, Sahakian BJ (2004): Relationship between ecstasy use and depression: a study controlling fro polydrug use. Psychopharmacology, 173(3-4):411-417.

Scholey AB, Parrott AC, Buchanan T, Heffernan TM, Ling J, Rodgers J. (2004): Increased intensity of Ecstasy and polydrug usage in the more experience recreational Ecstasy/MDMA users: A WWW study. Addictive Behaviours, 29:743-752

Sherlock K; Connor M (1999): Patterns of ecstasy use amongst club-goers on the UK 'dance scene'. International Journal of Drug Policy, 10:117-129

Soar K, Parrott AC. (2002). Problematic ecstasy use: is it due to patterns of ecstasy use? Journal of Psychopharmacology, 16(3): G4, A58.

Soar K, Turner JJD, Parrott A. (2001) Psychiatric disorders in ecstasy (MDMA) users: a literature review focusing on personal predisposition and drug history. Human Psychopharmacology Clinical Experimental, 16:641-645

Soar K, Turner JJD. & Parrott AC. (2006) Problematic versus non-problematic Ecstasy/MDMA use: the influence of drug usage patterns and pre-existing psychiatric factors. Journal of Psychopharmacology, 20(3):417-724

Strote J, Lee JE, Wechsler H. (2002): Increased MDMA use among college students: results of a national survey. Journal of Adolescent Health, 30: 64-72.

Thomasius R, Petersen K, Buchert R, Andresen B, Zapletalova P, Wartberg L, Nebeling B, Schmoldt A. (2003): Mood, cognition and serotonin transporter availability in current and former ecstasy (MDMA) users. Psychopharmacology, http://Fireball/Alex/thomasius_2003.html Published on line March 2003.

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

Verheyden SL, Henry JA, Curran VH. (2003): Acute, sub-acute and long-term subjective consequences of 'ecstasy' (MDMA) consumption in 430 regular users. Human Psychopharmacology, 18: 507-517

Verheyden SL, Maidment R, Curran VH. (2003): Quitting ecstasy: An investigation of why people stop taking the drug and their subsequent mental health.
Journal of Psychopharmacology, 17(4): 371-378

Webb E, Ashton CH, Kelly P, Kamali F. (1996): Alcohol and drug use in the UK university students. The Lancet, 348:922-925.

de Win MML, Schilt T, Reneman L, Vervaeke H, Jager G, Dijkin S, Booji J, van den Brink W. (2006): ecstasy use and self-reported depression, impulsivity, and sensation seeking a prospective cohort study. Journal of Psychopharmacology, 20(2): 226-235.

Winstock AR, Griffiths P, Stewart D. (2001): Drugs and the dance music scene: a survey of current drug is patterns among a sample o dance music enthusiasts in the UK. Drug and Alcohol Dependence, 64: 9-17.