Young adults’ trajectories of Ecstasy use: a population based study

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ABSTRACT

Young adults’ Ecstasy use trajectories have important implications for individual and population-level consequences of Ecstasy use, but little relevant research has been conducted. This study prospectively examines Ecstasy trajectories in a population-based sample. Data are from the Natural History Study of Drug Use, a retrospective/prospective cohort study conducted in Australia. Population screening identified a probability sample of Ecstasy users aged 19-23 years. Complete data for 30 months of follow-up, comprising 4 time intervals, were available for 297 participants (88.4% of sample). Trajectories were derived using cluster analysis based on recent Ecstasy use at each interval. Trajectory predictors were examined using multinomial logistic regression and included Ecstasy dependence (World Health Organisation Composite International Diagnostic Instrument), psychological distress (Hospital Anxiety Depression Scale), aggression (Young Adult Self Report) and contextual factors (e.g. attendance at electronic/dance music events). Three Ecstasy trajectories were identified (low, intermediate and high use). At its peak, the high-use trajectory involved 1-2 days Ecstasy use per week. Decreasing frequency of use was observed for intermediate and high-use trajectories from 12 months, independently of market factors. Intermediate and high-use trajectory membership was predicted by past Ecstasy consumption (> 70 pills) and attendance at electronic/dance music events. High-use trajectory members were unlikely to have used Ecstasy for more than 3 years and tended to report consistently positive subjective effects at baseline. Given the social context and temporal course of Ecstasy use, Ecstasy trajectories might be better understood in terms of instrumental rather than addictive drug use patterns.

Keywords: Ecstasy (MDMA), drug use trajectories, early adulthood, social environment, maturational factors, drug dependence
1. Introduction

Drug use trajectories have a fundamental bearing on the individual and social consequences of drug use and the policy measures required (Hser, Hamilton, & Niv, 2009). The appropriate design of interventions largely depends upon whether young adults who recurrently use particular drugs are likely to ‘spontaneously’ reduce or cease use, or persist over a longer life-period in spite of sometimes adverse consequences. The persistence and intensity of drug use patterns may have important implications for the nature of acute and long-term harms. With regard to Ecstasy (3,4-methylenedioxymethamphetamine; MDMA), a growing body of research indicates that cumulative Ecstasy use exposures could be positively correlated with neuropsychological harm (Biezonski & Meyer, 2011; Fernandez-Serrano, Perez-Garcia, & Verdejo-Garcia, 2011; Nulsen, Fox, & Hammond, 2010). Considerable information is available concerning trajectories of use for stimulant drugs such as cocaine and methamphetamine. Yet, despite extensive literature on the potential harms of Ecstasy use, there is little evidence concerning Ecstasy use trajectories.

1.1. Ecstasy use trajectories

Ecstasy is both a stimulant and a hallucinogen. It shares some pharmacological and subjective properties of each drug class, and many who use Ecstasy also use other stimulants and hallucinogens, often in settings such as ‘raves’ or other festivals and music events. For stimulants like methamphetamine and cocaine, trajectories beginning in early adulthood can span more than a decade (Hser, Huang, Brecht, Li, & Evans, 2008; Kertesz, et al., 2012). In contrast, hallucinogen trajectories are typically sporadic and short-lived (Nichols, 2004).

It is not known where Ecstasy fits on this spectrum. A prospective population-based German study of young people (initially aged 14-24 years) conducted over 3 to 4 years suggested that Ecstasy use may be transient, with a majority ceasing or reducing use within
the study period (von Sydow, Lieb, Pfister, Hofler, & Wittchen, 2002). Unfortunately, Ecstasy in this population study was grouped with stimulants and hallucinogens, making it impossible to distinguish the longitudinal patterns specific to Ecstasy. It is important for the duration and intensity of Ecstasy use to be specifically examined in other population settings.

1.2. Predictors of trajectories

Predictors of Ecstasy use trajectories have not previously been investigated. Trajectories for different drugs are related to their potential for eliciting physiological and/or psychological dependence (Anthony, Warner, & Kessler, 1994; Hser, et al., 2008; Hser, Longshore, & Anglin, 2007). Severe dependence is associated with longer and more intense trajectories. However, it is not clear how the construct of dependence applies to Ecstasy. Whereas drug dependence is a single-factor construct, Ecstasy dependence may have two underlying factors, namely ‘compulsion’ (e.g. unplanned use) and ‘escalation’ (Bruno, Matthews, Degenhardt, & Gomez, 2009; Degenhardt, Bruno, & Topp, 2010). The validity and utility of these constructs has not been assessed with regard to longitudinal patterns of use.

Life course studies indicate that many people ‘grow out’ of drug use (Chen & Kandel, 1995). A variety of individual and environmental characteristics (e.g. early exposure to drug use) may increase the likelihood of regular drug use during this period. Later, the emergence of structured commitments such as career and family may prompt a natural transition or deliberate reduction of drug use (Labouvie, 1996). Conversely, the fulfillment of age-relevant goals such as finding a sexual partner could usher in a new phase of life involving reduced use.

Other factors that may influence Ecstasy use trajectories have been identified in theories of drug use expectancies and instrumental drug use (Boys & Marsden, 2003; Müller
Expectancies may be formed through social contact with Ecstasy users and early subjective experiences of use. Furthermore, Ecstasy use could potentially be instrumental in the pursuit of adaptive personal goals during early adulthood, such as maintaining social networks, finding sexual partners, and discovering novel environmental stimuli. It has been observed that Ecstasy use can be predicated on attendance at events involving electronic/dance music (e.g. ‘raves’) where common personal goals are pursued (G.-J. Y. Peters & Kok, 2009; G. J. Peters, Kok, & Schaalma, 2008).

1.3. Market factors

There is a lack of evidence concerning the relationship between market factors and temporal changes in individual levels of Ecstasy use. Cross-sectional research indicates that market factors, including Ecstasy price, availability and quality, may influence consumption decisions (Abdallah, Scheier, Inciardi, Copeland, & Cottler, 2007; Goudie, Sumnall, Field, Clayton, & Cole, 2007). In addition, recent evidence suggests that the impact of market factors could be contingent on the extent of change and capacity of consumers to adapt (Brunt, Niesink, & van den Brink, 2012). Thus, it is plausible that increases or decreases in personal levels of Ecstasy use could, under some circumstances, be due to market changes rather than the natural course of Ecstasy trajectories.

This study identifies trajectories of Ecstasy use among a population sample of young adults, using cluster analysis of recent levels of Ecstasy across 4 data collection intervals spanning 30 months. Possible predictors of trajectories are examined, including participants’ demography, adolescent experiences, psychological health, facets of Ecstasy involvement including lifetime consumption and drug dependence, the social environment, subjective effects of Ecstasy use, and risk perceptions. The influence of market factors, such as price, availability and quality, on longitudinal changes in Ecstasy use is also assessed.
2. Methods

2.1. Participants

The Natural History Study of Drug Use (NHSDU) is a population-based retrospective/prospective longitudinal study of amphetamine-type stimulant (ATS) use. We used a novel application of population screening to develop a sampling frame and thereby recruit probability samples of young drug users and non-users. A one-page questionnaire examining lifetime drug use was mailed to 19 to 23 year olds. This age group was chosen because ATS use commences around this age (Australian Institute of Health and Welfare, 2008). An accompanying letter described the study as examining the health of young adults and did not highlight ATS use as a specific focus. Screening recipients were randomly selected from electoral roll data for Brisbane and the Gold Coast (Queensland, Australia). Voting is compulsory in Australia for all citizens aged 18 years and over. In June 2008 an estimated 82% of eligible 18 to 25 year olds were registered on the electoral roll [37]. The screening response rate was 49.9% (N=12,079).

The present study focuses exclusively on our sample of Ecstasy users. Screening respondents who used Ecstasy 3 or more times in the past 12 months (N=477) were eligible to participate. This eligibility criterion was used to exclude young adults at an ‘experimental’ stage of Ecstasy use. At the time of recruitment, 23 of the eligible respondents had either moved interstate or overseas or could not be contacted. Of the remainder, 336 (74.0%) consented to participate. Data was collected at 4 time intervals. Participants were interviewed face-to-face at baseline and 12 months, and surveyed via the Internet at 6 and 30 months. There was little variation between data collection modes regarding disclosure of drug use behavior, with no participants recanting Ecstasy use at 6 months and 0.3% (n=1) recanting at 30 months. From the original sample (N=336), 95.2% participated at 6 months, 89.5% at 12
months and 90.6% at 30 months. We had complete data across 4 time points for 297 participants or 88.4%.

2.2. Measures

2.2.1. Ecstasy consumption

We recorded number of days of Ecstasy use in the last month at each of 4 time intervals, coded as ‘no recent use’, ‘occasional use (1-2 times per month)’, ‘frequent use (3-4 times per month)’, and ‘very frequent use (5 or more times per month)’. The cluster analysis was based upon this variable. We also collected a self-reported estimate of the number of pills ever taken. A median of 70 pills was used as a cut-off to indicate high lifetime consumption. We differentiate between the intensity and duration of Ecstasy involvement by including a length of Ecstasy use variable calculated from the number of years since first Ecstasy use (0-3 years, 4-5 years, and 6-11 years). In addition, we created a variable distinguishing those who sometimes acquired Ecstasy to sell for profit from those who never did, given that dealing drugs is sometimes associated with greater levels of drug use (Herman-Stahl, Krebs, Kroutil, & Heller, 2007; Martins, Mazzotti, & Chilcoat, 2006).

2.2.2. Ecstasy dependence

Recent (30-day) and lifetime Ecstasy dependence was evaluated at baseline using the Illegal Drug Use Section of the World Health Organization’s Composite International Diagnostic Instrument (WHO-CIDI). The instrument applies diagnostic criteria for drug dependence from the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) and the International Classification of Diseases (ICD); we used DSM-IV diagnoses. Within the ‘club drug’ component of the WHO-CIDI we referred specifically to Ecstasy to the exclusion of other club drugs. There is reasonable individual-level concordance between WHO-CIDI
drug dependence diagnoses and those from semi-structured clinical interviews (positive predictive value of 82.0 for DSM-IV lifetime diagnoses of drug dependence with abuse; Haro, et al., 2006).

2.2.3. Drug use perceptions

At baseline and 12 months we asked about ‘positive’ psychological effects of Ecstasy (euphoria, increased confidence, increased libido, being talkative, being very friendly and increased empathy/understanding) and ‘negative’ effects (nervousness, panic attacks or anxiety, paranoia, irritability, aggression or hostility, hallucinations or delusions, tension, depression and mood swings). Positive and negative effects were coded differently, because positive effects were more common. Participants reporting at least 5 (out of 6) positive effects ‘every time or nearly every time’ they used Ecstasy were classed as having ‘strong positive effects’ and comprised approximately the upper quartile of participants. Those who experienced one or more negative psychological effects on most occasions were classed as having ‘strong negative effects’ and comprised roughly the 90th percentile.

At 30 months, we asked participants how risky it is to a person’s mental and physical health to use Ecstasy. A dichotomous variable was created to distinguish those who perceived Ecstasy to be ‘very risky’.

2.2.4. Drug use environment

At baseline, knowing more than 10 Ecstasy users by name or face was designated as having a large set of Ecstasy-using social contacts. At 6 months we asked about visits to social or recreational venues during the previous 12 months. We created a dichotomous variable of ‘recurrent attendance’ at electronic/dance music events using a cut-off of attendance at \( \geq 2 \) events in the last 12 months.
2.2.5. Psychological factors

Psychological distress was evaluated using the Hospital Anxiety Depression Scale (HADS; Zigmond & Snaith, 1983), which provides a valid and reliable screen for psychological distress with a Cronbach’s alpha of 0.88 to 0.89 (Costantini, et al., 1999; Herrmann, 1997). A cut-off of 16 indicates high levels of distress (Bjelland, Dahl, Haug, & Neckelmann, 2002; Crawford, Henry, Crombie, & Taylor, 2001). Aggression was measured using the aggressive behavior subscale of the Achenbach Young Adult Self-Report Scale (YASR; Achenbach, 1997). The YASR is an age-appropriate measure with demonstrated validity (Wiznitzer, et al., 1992). Construct validation studies indicate the YASR has a Cronbach’s alpha of 0.84 averaged across each syndrome (Ferdinand & Verhulst, 1994) and 0.81 for the aggressive behavior syndrome (Najman, et al., 2009).

2.2.6. Market factors

At the 12 month follow-up we asked participants who used recently (past 12 months) how confident they were that their last pill of Ecstasy contained MDMA (very confident/confident; unsure/skeptical; no recent use). We also calculated the proportion of occasions in the last 12 months for which the effects of Ecstasy were very much weaker than participants were accustomed to (< 50% of occasions; ≥ 50% of occasions; no recent use). For participants who purchased Ecstasy in the past 6 months, we asked the usual price per pill (5-19 AUD; 20-25 AUD; 26-40 AUD; no recent purchases) and whether they were ever unable to obtain Ecstasy (rarely/never; sometimes/often; no recent attempts to obtain Ecstasy).

2.3. Data analysis
Trajectory groups were developed using kmeans cluster analysis of recent Ecstasy use at each time interval. Recent Ecstasy use was measured in days and standardized by recoding to 4 categories. Four cluster groups were specified. This number of clusters was decided on the basis of previous research (e.g. Hamil-Luker, Land, & Blau, 2004; Kertesz, et al., 2012) and with consideration of sample size. Two clusters, representing intermediate levels of use, overlapped and were combined to form a ‘intermediate use’ trajectory cluster. The other clusters were labeled as ‘low use’ and ‘high use’. Multinomial logistic regression, with low use as the base outcome, was conducted to assess factors associated with higher levels of use. In addition, we measured changes in levels of use between 6 and 12 months, by subtracting the recent days of use at 12 months from recent days of use at 6 months. A linear regression model was developed to assess the relative contribution of market factors and Ecstasy trajectories to decreased levels of use during this time interval. Data were analysed using Stata SE 11.0.

3. Results

3.1. Trajectories

Three cluster groups were identified based on participants’ days of Ecstasy use in the last month (30 days) at each data collection interval (Figure 1). These comprised a ‘low-use’ group (cluster 1), an ‘intermediate-use’ group (cluster 2) and a ‘high-use’ group (cluster 3). More than half of the participants (56.2%) were members of the intermediate-use group, while 35.7% were low-use and 8.1% were in the high-use group.

All Ecstasy trajectories were characterized by declining or low stable levels of use by the end of the study period. The intermediate-use group used Ecstasy more than once a month (but less than fortnightly) at baseline and showed sustained reduction in Ecstasy use from 6 months onwards. By comparison, the high-use group used Ecstasy nearly weekly at baseline.
and did not show sustained reduction until 12 months. A defining feature of the high-use group was initial escalation up to the level of using more than once a week at 6 months. The low-use group consumed Ecstasy very infrequently (i.e. not every month) but did not cease use altogether.

FIGURE 1 ABOUT HERE

3.2. Predictors of trajectories

Multinomial logistic regression was conducted to evaluate predictors of intermediate and high-use trajectories, with the low-use trajectory as the base outcome. As a first step, unadjusted analyses were conducted to identify variables that were associated with Ecstasy use trajectories (Table 1). While several factors were associated with both trajectories (e.g. previous levels of Ecstasy use and attendance at electronic/dance music events), some only related to the intermediate trajectory (e.g. negative association with risk perception). Other factors were only relevant to the high-use trajectory (e.g. positive association with recent Ecstasy dependence; negative association with being > 20 years old and using Ecstasy for a longer period). Psychological distress and aggressive behavior were not associated with Ecstasy trajectories.

TABLE 1 ABOUT HERE

We conducted multinomial logistic regression, with adjustment for all variables included in the final model, to identify independent predictors of Ecstasy trajectories (Table 2). Some predictors were common to the two ‘higher-end’ trajectory groups. Attendance at electronic/dance music events and high levels of lifetime Ecstasy use prior to baseline (> 70 pills ever) were predictive of intermediate and high-use trajectories.
Membership of the high-use trajectory was predicted, in particular, by experiencing strong positive subjective effects of Ecstasy at baseline (Table 2). However, reporting the same subjective effects at the 12 month follow-up was not predictive of this trajectory. The association between recent (30 day) Ecstasy dependence and membership of the high-use trajectory was non-significant, probably because of the low numbers who were assessed as dependent.

Membership of the intermediate-use trajectory was predicted by risk perception (Table 2). Those who perceived Ecstasy use to be very risky were more likely to have a low trajectory of Ecstasy use, rather than an intermediate trajectory. Risk perceptions were not associated with the high-use trajectory. In addition, those who were married or in a de facto relationship were less likely to be members of the intermediate-use trajectory.

TABLE 2 ABOUT HERE

3.3. Market factors and changing levels of use

We developed a linear regression model to assess the impact of market factors versus trajectory groupings on changes in levels of Ecstasy use from 6 to 12 months. This period represented the most substantial decrease for the intermediate and high-use trajectory groups. There was no apparent association between levels of Ecstasy use and Ecstasy price or availability, but there were modest effects of Ecstasy quality. In the unadjusted analyses, being ‘unsure/skeptical’ that the pills used contained MDMA (vs. being confident that they did), was associated with an estimated decrease of 0.73 days of recent Ecstasy use. In the full model, adjusted for Ecstasy use trajectories and all market variables, experiencing weaker effects on at least 50% of the occasions of Ecstasy use was associated with a decrease of 0.74 days. However, the Ecstasy trajectory groups were the strongest predictors of decreased use in the unadjusted and full regression analyses. In the adjusted model, being in the
intermediate-use trajectory was associated with a decrease of 1.07 days, while being part of the high-use trajectory was associated with a decrease of 4 days.

TABLE 3 ABOUT HERE

4. Discussion

The NHSDU is the first study to prospectively examine young adults’ Ecstasy use trajectories and identify relevant predictors. The study recruited a population sample of recurrent users (i.e. had used Ecstasy ≥ 3 times in the year before the study). Our findings support earlier prospective research suggesting that young people’s Ecstasy use is relatively transient (von Sydow, et al., 2002). Further, we note the existence of dynamic trajectories involving rapid changes in levels of Ecstasy use. Our cluster analysis, based on recent Ecstasy use at four time intervals across 30 months, identified three distinct trajectories. Two trajectories in our study were characterized by declining levels of Ecstasy use after 6 months (‘intermediate’ and ‘high-use’ groups), while the third involved stable levels of negligible recent use (‘low-use’ group). Less than one-in-ten participants belonged to the ‘high-use’ trajectory, which escalated during the first 6 months to using Ecstasy 1-2 days per week, but subsequently declined considerably.

4.1. Ecstasy use patterns and dependence

Membership of the intermediate and high-use trajectories (as opposed to the low-use trajectory) was reliably predicted by high lifetime quantities of Ecstasy use (at baseline) but not by Ecstasy dependence (12 month or lifetime). This suggests that young adults’ intermediate and high-use trajectories could be characteristic of intermittent binge drug use rather than dependent drug use. Two aspects of the DSM-IV assessment of Ecstasy dependence in our study support this conclusion. Very few participants endorsed the
‘volitional’ aspect of compulsive Ecstasy use (a persistent desire or unsuccessful attempts to cut down). Secondly, only around 5% of participants were dependent in the last 12 months. Young adults’ Ecstasy use patterns might not be dissimilar to those for alcohol, in the sense of binge patterns of drug use that are driven by users’ expectancies (Morawska & Oei, 2005).

4.2. Social settings and perceptions

Our findings concerning social activities suggest that young adults’ Ecstasy use is largely motivated by social-recreational goals. Those who recurrently attended electronic/dance music events were around 3 times more likely than other participants to be part of the intermediate-use trajectory and 4 times more likely to be in the high-use trajectory. Similarly, the self-reported ‘positive’ psychological effects of Ecstasy predicted membership of the high-use trajectory. These subjective effects are oriented toward experiences of interpersonal connectedness and physical intimacy. Consequently, young adults’ Ecstasy use trajectories could represent instrumental rather than addictive behavior, especially given their limited temporal course (Hopper, et al., 2006; Ramo, Grov, Delucchi, Kelly, & Parsons, 2011). At the same time, being married or in a de facto relationship was associated with low levels of Ecstasy use. This is consistent with changing social goals for these young adults.

While being part of the high-use trajectory was associated with positive subjective effects reported at baseline, this was not the case at the 12 month follow-up. Levels of Ecstasy use for this trajectory declined around the same time. These changes are consistent with the rapid development of chronic tolerance observed specifically in regard to Ecstasy use (Parrott, 2005; Verheyden, Henry, & Curran, 2003). Some users may initially compensate by increasing Ecstasy dosage, but it also appears that a diminution of positive effects may eventually decrease the motivation to use. Few negative effects were reported at baseline or 12 months.
4.3. Psychological factors

Unlike previous longitudinal research (Huizink, Ferdinand, van der Ende, & Verhulst, 2006; Lieb, Schuetz, Pfister, von Sydow, & Wittchen, 2002), we assessed psychological distress (i.e. symptoms of anxiety and depression) in early adulthood rather than adolescence and we examine subsequent changes in frequency of Ecstasy use. Previous studies suggest that psychological distress in adolescence may lead to later Ecstasy use, perhaps due to self-medication. However, we found no relationship between young adults’ psychological distress and their Ecstasy use trajectories. Our findings suggest that, if young people are using Ecstasy to self-medicate, they are doing so in adolescence, in temporal proximity to the experience of psychological distress. An alternative explanation is that distressed young adults don’t use Ecstasy any more frequently than most other young adult users.

4.4. Declining Ecstasy use

We examined the association between market factors and longitudinal changes in Ecstasy use levels. Of all the relevant factors, only perceived changes in Ecstasy quality contributed to decreases in recent Ecstasy use. This contribution was relatively small, especially with regard to the high-use trajectory. Ecstasy price and changes in availability did not appear to influence changing levels of use. This may reflect the nature of recent Ecstasy market changes in Australia, which appeared to have impacted on Ecstasy quality rather than price and availability (Sindicich & Burns, 2010). Overall, market factors did not appear to greatly influence changing levels of use.

Ecstasy users’ trajectories accounted for significant decreases in use, between the 6 month and 12 month follow-up, independently of Ecstasy market factors. These changes are consistent with a pattern of regression to the mean, with the greatest decrease being for the high-use trajectory, a smaller decrease for the intermediate trajectory and a relatively stable
pattern for the low-use trajectory. This pattern of regression may reflect the natural history of Ecstasy use and the temporal focus of our study (Healy & Goldstein, 1978; Stout, 2008). Our prediction model of Ecstasy trajectories is suggestive of a temporal trend toward stable patterns of infrequent use in the longer-term, given that young adults who had been using for 4 years or longer were unlikely to be part of the high-use trajectory.

4.5. Strengths and limitations

This is a rare population-based prospective study of young adult Ecstasy users, recruited early in the period of their Ecstasy use, and our good participant retention after 30 months also contributes to informative mapping of trajectories. However, a number of study limitations should be noted. Firstly, although the screening response rate was reasonable compared to those routinely attained from mail-out surveys (Breen, Shakeshaft, Doran, Sanson-Fisher, & Mattick, 2010; Ryu, Couper, & Marans, 2006) bias may have resulted from non-response. Nonetheless, estimates we obtained from screening are similar to other population drug use estimates (Australian Institute of Health and Welfare, 2008) and participation rates in the NHSDU were similar for Ecstasy users and non-users. Secondly, the findings are period and cohort-specific and reflect the background prevalence of use. Thirdly, while the follow-up period of 30 months was adequate to observe major turning points in trajectories, follow-up over a longer timeframe is required to evaluate possible long-term problematic use. Additionally, we did not assess responses to drug and alcohol treatment or drug education campaigns as potential influences on decreases in Ecstasy use. In Australia there are very low rates of treatment for Ecstasy-related problems, but there has been considerable exposure to relevant campaigns. Future research should evaluate the effects of interventions on the natural history of Ecstasy use. Finally, the trajectory groups are statistically derived rather than theory-based and do not represent a formal classification.
5. Conclusions

Our prospective population-based study indicates that a majority of young adult Ecstasy users consume Ecstasy relatively infrequently and have declining levels of use before reaching their mid-twenties. Around one-in-ten have more intensive patterns of use which also decline during this period. The heavier patterns we observed appear to be characteristic of ‘binge’ rather than dependent patterns of drug use. Young adults’ regular Ecstasy use is explicable in terms of the preponderance of positive compared to negative effects they report and also the extent of their involvement in recreational settings where Ecstasy is used. Given the transient but sometimes intensive nature of Ecstasy use, policy makers should respond to acute dangers, including toxicity due to drug interactions and engagement in risk behavior such as drug driving (Kuypers, Bosker, & Ramaekers, 2009; Mohamed, Hamida, Cassel, de Vasconcelos, & Jones, 2011). More research is required to understand the extent to which long-term neuropsychological harm results from intensive short-term Ecstasy use (Biezonski & Meyer, 2011; Green, King, Shortall, & Fone, 2012). However, the nature of Ecstasy use trajectories we observed suggest that the public health and social burden associated with Ecstasy use may be limited.
References


Trajectories of Ecstasy use


with standardized clinical assessments in the WHO World Mental Health Surveys.


Table 1
Unadjusted relative risk estimates for Ecstasy use trajectories (intermediate and high use; N=297)*

<table>
<thead>
<tr>
<th>Demography</th>
<th>N exposed</th>
<th>N not exposed</th>
<th>% exposed group a</th>
<th>% non-exposed group a</th>
<th>RR - moderate use (95% CI)</th>
<th>RR - high use (95% CI)</th>
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<tbody>
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<td>Completed secondary education c</td>
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<td>87</td>
<td>31.0</td>
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<td>46.0</td>
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<td>179</td>
<td>42.5</td>
<td>49.1</td>
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<td>33.3</td>
<td>59.3</td>
<td>7.4</td>
<td>36.2</td>
</tr>
<tr>
<td>Ecstasy dependence (recent) j</td>
<td>17</td>
<td>280</td>
<td>11.8</td>
<td>70.6</td>
<td>17.7</td>
<td>37.1</td>
</tr>
<tr>
<td>Ecstasy dependence (lifetime) i</td>
<td>105</td>
<td>192</td>
<td>26.7</td>
<td>62.9</td>
<td>10.5</td>
<td>40.6</td>
</tr>
<tr>
<td>Social environment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Know &gt; 10 Ecstasy users</td>
<td>270</td>
<td>27</td>
<td>53.9</td>
<td>57.8</td>
<td>8.5</td>
<td>33.7</td>
</tr>
<tr>
<td>Regular electronic/dance events h</td>
<td>143</td>
<td>154</td>
<td>21.0</td>
<td>67.8</td>
<td>11.2</td>
<td>49.4</td>
</tr>
<tr>
<td>Perceptions of Ecstasy use</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceive Ecstasy use is very risky</td>
<td>86</td>
<td>211</td>
<td>48.8</td>
<td>44.2</td>
<td>7.0</td>
<td>30.5</td>
</tr>
<tr>
<td>Strong positive effects (baseline) k</td>
<td>101</td>
<td>196</td>
<td>26.7</td>
<td>61.4</td>
<td>11.9</td>
<td>40.3</td>
</tr>
<tr>
<td>Strong positive effects (12 mths)</td>
<td>62</td>
<td>235</td>
<td>24.2</td>
<td>69.4</td>
<td>6.5</td>
<td>38.7</td>
</tr>
<tr>
<td>Negative effects (baseline) l</td>
<td>35</td>
<td>262</td>
<td>40.0</td>
<td>51.4</td>
<td>8.6</td>
<td>35.1</td>
</tr>
<tr>
<td>Negative effects (12 mths) m</td>
<td>17</td>
<td>280</td>
<td>29.4</td>
<td>64.7</td>
<td>5.9</td>
<td>36.1</td>
</tr>
</tbody>
</table>

* Relative risk of intermediate and high use trajectories with low use trajectory as the base outcome; a Per cent of exposed/non-exposed group belonging to each trajectory; 
b Received final secondary school grading; c Suspended or expelled from school; d Measured using Hospital Anxiety Depression Scale; e Measured using aggression subscale of Young Adult Self Report; f Used > 70 pills ever; g Reference category is 0-3 years of Ecstasy use; h Ecstasy dependence assessed using WHO-CIDI (recent dependence refers to last 12 months); i Attended electronic/dance music event ≥2 times in last 12 months; j Report consistent experience of high number of positive psychological effects; 
k Report consistent experience of any negative psychological effects.

p < 0.05, ** p < 0.01, *** p < 0.001
Table 2
Prediction model of Ecstasy use trajectories (intermediate and high use; N=297)

<table>
<thead>
<tr>
<th></th>
<th>RR - intermediate use (95% CI)</th>
<th>RR - high use (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (over 20 years)</td>
<td>1.07*</td>
<td>0.83f</td>
</tr>
<tr>
<td>Married or de facto</td>
<td>0.48 (0.25-0.94)*</td>
<td>0.12 (0.01-1.00)</td>
</tr>
<tr>
<td>Studying full-time</td>
<td>1.33*</td>
<td>1.18g</td>
</tr>
<tr>
<td>Completed secondary education(^{b})</td>
<td>1.46*</td>
<td>2.27*</td>
</tr>
<tr>
<td>Ever suspended from school(^{c})</td>
<td>0.72*</td>
<td>2.50*</td>
</tr>
<tr>
<td>High lifetime consumption(^{d})</td>
<td>2.50 (1.40-4.46)**</td>
<td>5.98 (2.14-16.70)**</td>
</tr>
<tr>
<td>Length use: &gt; 3 years(^{e})</td>
<td>0.83 (0.46-1.51)</td>
<td>0.20 (0.05-0.78)*</td>
</tr>
<tr>
<td>Ecstasy dependence (recent)(^{f})</td>
<td>3.15 (0.62-15.98)</td>
<td>5.69 (0.79-41.23)</td>
</tr>
<tr>
<td>Ecstasy dependence (lifetime)(^{f})</td>
<td>1.46*</td>
<td>1.25*</td>
</tr>
<tr>
<td>Regular electronic/dance events(^{g})</td>
<td>3.56 (2.02-6.25)***</td>
<td>4.12 (1.48-11.46)**</td>
</tr>
<tr>
<td>Ecstasy use – very risky</td>
<td>0.45 (0.25-0.81)**</td>
<td>0.47 (0.16-1.40)</td>
</tr>
<tr>
<td>Strong positive effects (baseline)(^{h})</td>
<td>1.78 (0.99-3.20)</td>
<td>3.18 (1.17-8.64)*</td>
</tr>
<tr>
<td>Strong positive effects (12 mths)(^{h})</td>
<td>1.52*</td>
<td>0.65*</td>
</tr>
</tbody>
</table>

\(^{a}\) Base outcome is the low use trajectory; \(^{b}\) Received final secondary school grading; \(^{c}\) Suspended or expelled from school; \(^{d}\) Used > 70 pills ever; \(^{e}\) Reference category is 0-3 years of Ecstasy use; \(^{f}\) Ecstasy dependence assessed using WHO-CIDI (recent dependence refers to last 12 months); \(^{g}\) Attended electronic/dance music event ≥2 times in last 12 months; \(^{h}\) Reported consistent experience of high number of positive psychological effects.

\(^*\) Not included in final model; non-significant at \(p < 0.05\).

\(p < 0.05\), \(** p < 0.01\), \(*** p < 0.001\)
## Table 3
Prediction model of decrease in number of days of Ecstasy use, from 6 to 12 month follow-up (N=297)\(^a\)

<table>
<thead>
<tr>
<th></th>
<th>% of sample</th>
<th>Unadjusted coef. (95% CI)</th>
<th>Adjusted coef. (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Price</strong>(^b)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-25 dollars</td>
<td>42.1</td>
<td>-0.12 (-1.05-0.81)</td>
<td>0.34 (-0.56-1.23)</td>
</tr>
<tr>
<td>26-40 dollars</td>
<td>3.7</td>
<td>-0.84 (-2.48-0.79)</td>
<td>0.09 (-1.45-1.64)</td>
</tr>
<tr>
<td>No recent purchase</td>
<td>44.1</td>
<td>-0.46 (-1.38-0.46)</td>
<td>0.38 (-1.10-1.85)</td>
</tr>
<tr>
<td><strong>Unable to obtain Ecstasy</strong>(^c)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Often</td>
<td>21.9</td>
<td>-0.11 (-0.82-0.61)</td>
<td>0.39 (-1.09-0.30)</td>
</tr>
<tr>
<td>No recent use</td>
<td>39.7</td>
<td>-0.25 (-0.85-0.34)</td>
<td>0.25 (-1.12-1.61)</td>
</tr>
<tr>
<td><strong>Weaker effects</strong>(^d)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On at least half the occasions</td>
<td>18.9</td>
<td>0.61 (-0.09-1.31)</td>
<td>0.74 (0.02-1.45)*</td>
</tr>
<tr>
<td>Haven’t used last 12 mths</td>
<td>24.2</td>
<td>-0.31 (-0.94-0.32)</td>
<td>-- (^g)</td>
</tr>
<tr>
<td><strong>‘Real’ Ecstasy</strong>(^e)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unsure/Skeptical</td>
<td>38.7</td>
<td>0.73 (0.13-1.33)*</td>
<td>0.41 (-0.21-1.03)</td>
</tr>
<tr>
<td>Haven’t used last 12 mths</td>
<td>24.2</td>
<td>-0.10 (-0.77-0.58)</td>
<td>0.38 (-0.46-1.22)</td>
</tr>
<tr>
<td><strong>Trajectories</strong>(^f)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intermediate use</td>
<td>56.2</td>
<td>0.86 (0.32-1.39)**</td>
<td>1.07 (0.46-1.68)**</td>
</tr>
<tr>
<td>High use</td>
<td>8.1</td>
<td>3.67 (2.70-4.65)**</td>
<td>4.00 (2.93-5.06)**</td>
</tr>
</tbody>
</table>

\(^a\) Linear regression model reporting coefficients with 95% confidence interval. Unit of measurement for the coefficient is the change (decrease) in last month days of use from 6 month to 12 month data collection intervals. Negative values represent an increase; \(^b\) Refers to purchases within the previous 6 months. Reference category is 5-19 dollars (Australian). \(^c\) Refers to attempts to obtain within the previous 6 months. Reference category is never/rarely unable to obtain Ecstasy. \(^d\) Participant asked how often (in last 12 months) the effects of Ecstasy they consumed were weaker than usual. Reference category is less than half the occasions of Ecstasy use. \(^e\) Participant asked how confident they were that the last Ecstasy pill they consumed contained real Ecstasy/MDMA. Reference category is very confident/confident; \(^f\) Reference category is the low use trajectory; \(^g\) Omitted due to collinearity.

* p < 0.05; ** p < 0.01; *** p < 0.001.
Fig. 1. Ecstasy use trajectories over a 30 month period representing three clusters of longitudinal Ecstasy use patterns: high-use, n=24 (8.1%), intermediate-use, n=167 (56.2%), and low-use, n=106 (35.7%). Note: Mean days of Ecstasy use refers to the number of days that Ecstasy was used during the last month at each time interval. Trajectory groups were developed using kmeans cluster analysis.
Highlights

- We examine Ecstasy use trajectories over 30 months in a young adult population
- Low (36%), intermediate (56%), high-use (8%) groups identified by cluster analysis
- All trajectories comprised low/declining levels of use from 12 months onwards
- High-use trajectory peaked at 1-2 days Ecstasy use per week
- High-use linked to subjective effects, social setting and length of use (≤ 3 years)