University of South Australia

Psychological constructs associated with 3, 4-methylenedioxymethamphetamine (Ecstasy/MDMA) abuse. Evidence of underlying, serotonergic neurotoxicity.

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Statement of Authorship

This thesis contains no material which has been accepted for the award of any other degree or diploma in any tertiary institution. Except for the in-text references, this thesis also contains no material previously published or written by any other author.

Signed.....

Lisa Elizabeth Irvine

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Abstract

The illicit psycho-stimulant 3, 4-Methylenedioxymethamphetamine MDMA/Ecstasy), has gained widespread popularity as a recreational drug over the past decade. The acute psychological effects of MDMA include euphoria, exhilaration, altered sensory perception and de-realisation due to an influx of extra-cellular 5-Hydroxytraptamine (5-HT/serotonin) and dopamine. Pharmacodynamic research suggests that this occurs due to the inhibition of re-uptake mechanisms and the reduction of metaboliser enzymes such as Tryptophan Hydroxylase. Clinical studies also suggest that these neurochemical reactions result in cortical damage. That is, long-term, repeated exposure can lead to a decrease in the densities of serotonergic transporter sites and damage to the ascending axonal projections of the dorsal Raphe nuclei. Therefore, to assess the extent of cortical 5-HT impairment, researchers have tested psychological constructs related to central serotonergic activity. However, current research is characterised by several methodological flaws. Hence, this study attempted to replicate the findings of previous psychological research whilst controlling for several extraneous variables. These included polydrug use, co-administration, recent MDMA exposure and items within personality inventories that specifically relate to drug use. A sample of 120 non-users, recreational ecstasy users and chronic ecstasy users completed self-report inventories measuring depression, anti-social behaviour, impulsivity, sensation seeking, extraversion and paranoia. A drug use index measuring ecstasy use was also completed. Subsequent results demonstrated significant between-group differences on all personality measures. Thus, the current study provides further evidence that MDMA is indeed a serotonin neurotoxin, which can produce a range of psychobiological changes during early-stage ecstasy use. Given the current findings, an effective primary prevention and 'harm minimisation' strategy is recommended to reduce the prevalence of ecstasy use and ecstasy-related harm in the community.

Introduction

1.1 The Ecstasy epidemic

3, 4-Methelynedioxymethamphetamine (MDMA/Ecstasy), a ring-substituted derivative of methamphetamine, represents one of a number of 'designer drugs' associated with the recent formation of a 'party-drug' youth culture (Cole & Sumnall, 2003). The acute psychoactive effects of MDMA include euphoria, de-realisation, altered sensory perception, energy and intense exhilaration (McCann & Ricaurte, 1995). For these reasons, the substance has been compared to the psychostimulant Methamphetamine and the hallucinogen Mescaline and has rapidly become a drug of abuse (Nichols, 1986). As such, MDMA has been classified as a Schedule 1 Illicit Substance in the Federal Government's Controlled Substance Act (1984). This legislation has been passed both internationally and domestically (Cole & Sumnall, 2003).

Despite these efforts, epidemiological studies have shown that ecstasy use is increasing. The National Drug Strategy Household Survey found that 19.7% of 20-29 year olds experimented with ecstasy in 2002, representing a 5.1% increase in the last four years (Australian Institute of Health and Welfare [AIWH], 2002). Likewise, the International Narcotics Control Board (United Nations [UN], 2003) reported that ecstasy use in Europe has steadily increased over the past decade, due to the proliferation of dance events known as 'raves'. Hence, the United Nations General Assembly, in a Special Session on the World Drug Problem, recently affirmed that the ecstasy epidemic has become a major global health concern (UN, 2003).

Indeed, neurological research suggests that recurrent MDMA intake can lead to pronounced cortical abnormalities (Hatzidimitriou, McCann, Ricaurte, 1999). Studies have found long-term cerebral 5-Hydroxytryptamine (5-HT/serotonin) depletion in the stratium, hippocampus, pre-frontal cortex and limbic system following MDMA exposure (Reneman et al., 2001; Semple, Ebmeier, Glabus, O'Carroll, & Johnstone, 1999). Such deficits are related to pre-synaptic vesicle degeneration and a reduction in the density of serotonergic transporter sites (Dafters, Duffy, O'Donnell, & Bouquet, 1999; McCann, Szabo, Scheffel, Dannals, & Ricaurte, 1998; Sabol, Lew, Richards, Vosmer, & Seiden, 1996). Hence, MDMA has been labelled a 'selective serotonin neurotoxin' (Ricaurte, Yuan, & McCann, 2000, p.7).

However, neurological research has been criticised on methodological grounds. There is evidence that current neurological procedures cannot accurately detect MDMA-induced neurotoxicity in humans due to technological limitations (Heinz & Jones, 2000). As a result, researchers have relied on standardized, psychological tests to assess long-term, cortical damage (Gouzoulis-Mayfrank, Becker, Pelz, Tuchenhagen, & Daumann, 2002; Morgan; 1998; Parrot et al., 2002; Parrot, Sisk, & Turner, 2000; Schifano et al., 1998; Zakzanis, Young & Radkhoshnoud; 2002). By testing psychological constructs related to central serotonergic activity, it has been possible to estimate the extent of neurotoxicity (Gouzoulis-Mayfrank et al., 2002). Indeed, many experts contend that such methods can be more sensitive to underlying, functional abnormalities than conventional brain imaging techniques (Swiercinsky, 2002).

However, current psychological research is also characterised by several methodological weaknesses (Cole & Sumnall, 2003). As a result, the 'MDMA neurotoxicity' hypothesis remains tenuous. First, researchers have failed to exclude participants who consumed MDMA within a week of testing despite transitory monoamine depletion in brain structures related to emotion and behaviour (Battaglia, Yeh, & De Souza, 1988; Curran & Travil, 1997; Semple et al., 1999). Thus, it is unknown whether psychopathology persists after the residual effects of MDMA are controlled. Second, psychological assessment tools have been employed without the preclusion of items relating to drug use (Arnett, 1994). For this reason, the correlations reported in the current literature may be overestimated. Third, studies have failed to control for polydrug use, and therefore it is unclear whether psychopathology is symptomatic of MDMA alone or a combination of psychoactive drugs (Steele, McCann, & Ricaurte, 1994).

Thus, having established that ecstasy use is a burgeoning phenomenon of psychological concern, and that important research questions remain unanswered, attention is next focused on the current neurological and psychological literature. In addition, major methodological confounds will be discussed in order to delineate the need for a cohesive and soundly conceptualised research study.

1.2 Neurological findings and major methodological confounds

Psychopharmacological research suggests that the acute, subjective effects of MDMA are mediated by an influx of extra-cellular 5-HT and dopamine at the synaptic level (Crespi, Mennini, & Gobbi, 1997). This occurs due to the inhibition of re-uptake mechanisms and a reduction of metaboliser enzymes such

as Tryptophan Hydroxylase and Monoamine Oxidase (Vuori et al., 2003). As a result of these immediate pharmacologic effects, residual levels of 5-HT and dopamine must spontaneously auto-oxidize, releasing known neurotoxic metabolites and potentially toxic levels of hydrogen peroxide (Commins & Vosmer, 1987; Sprague, Everman, & Nichols, 1998). Together, these neurochemical reactions damage the ascending projections of the dorsal Raphe nuclei, which constitute the serotonergic system pathways in the neo-cortex and limbic system (Molliver, Berger, & Mamounas, 1990). Hence, cortical levels of 5-HT remain depleted due to functional, axonal impairment (Molliver et al., 1990). Interestingly, although studies have found reductions in noradrenergic and dopaminergic basal levels following MDMA intake (Commins & Vosmer, 1987), these declines are comparatively minor and are rarely statistically significant (Cole & Sumnall, 2003; Ricaurte, Yuan, Hatzdimitriou, Cort, & McCann, 2002). Hence, MDMA-induced neurotoxicity is most prominent with the serotonergic system (Ricaurte et al., 2002).

To assess the extent of 5-HT impairment in vivo, Semple et al. (1999) used a specific serotonin transporter ligand labeled [123]-β CIT. The sample comprised ten chronic ecstasy users who had consumed a lifetime dose of approximately 50 ecstasy tablets and ten ecstasy-naïve controls. Subsequent Single Photon Emission Computed Tomography (SPECT) analyses showed global reductions in serotonergic transporter sites (SERTS) as well as pronounced localized decrements within the left calcarine cortex, a structure related to the visuo-spatial sketchpad (Baddeley & Hitch, 1994), and the midline limbic region.

These deficits were not detectable in the brain imaging scans of non-ecstasy user controls.

Several studies have supported these results. Reneman et al. (2001) found systemic 5-HT reductions using radioligand analysis with both current and ex-MDMA users. The researchers reported a 9% reduction in overall SERT densities, with the hippocampus and pre-frontal cortex showing the most pronounced declines. Similarly, clinical research with rhesus monkeys, using anatomic analysis, found an 83-95% decline in the density of axonal fibres subsequent to MDMA administration (Hatzidimitriou et al., 1999). This decline was evident within numerous neo-cortical regions, including the limbic system and stratium - the latter of which exhibited an 80% decrease in 5-HT axon density. Although the medial and dorsal raphe nuclei did not exhibit signs of neuro-degeneration, synaptic vesicle damage was evident throughout the entire cortex.

Other studies using indirect measures of serotonergic function have found declines in peripheral 5-HT concentrations. McCann and Ricaurte (1995) reported a correlation between MDMA exposure and reduced cerebro-spinal fluid (CSF) concentrations of 5-Hydroxyindoleacitic Acid (5-HT 1AA) - the major metabolite of serotonin (McCann & Ricaurte, 1995). This finding was replicated in later studies by Bolla, McCann and Ricaurte (1998).

Hence, neurological research has consistently found 5-HT system deficits in recreational user populations. However, these conclusions are tentative due to

methodological limitations. Specifically, data obtained using SPECT with the radioligand [123]-β CIT has been criticised as the substance demonstrates a low affinity with post-synaptic 5-HT receptors (Heinz & Jones, 2000). The ligand itself is known to biodegrade before it reaches the 5-HT receptor targets (Heinz & Jones, 2000). Also, the reliability of non-human primate testing is contentious, particularly since other species show different pharmacokinetic reactions to MDMA (Reneman et al., 2001). Moreover, peripheral 5-HT measures cannot accurately reflect cortical neurochemistry activity (Heinz & Jones, 2000).

Given these shortcomings, experts have instead administered psychological inventories to assess underlying 5-HT abnormalities. This is because 5-HT is known to play a key role in the aetiology of many clinical disorders (Lesch, 1996; Mann, 1996). Likewise, due to high-density serotonergic transporter sites in the limbic system and pre-frontal cortex, 5-HT is involved in modulating affective states, fear response, forward planning and executive processing (Tse & Bond, 2002). Therefore, although psychopathology and related disorders are mediated by complex monoamine interactions, particular psychological disturbances are clearly indicative of serotonergic system impairment (Gouzoulis-Mayfrank et al., 2002).

Numerous psychological studies have used this approach to assess the extent of neurotoxicity subsequent to MDMA exposure, and have specifically examined the constructs depression, anti-social behaviour, impulsivity, sensation seeking, extraversion and paranoia. These, in turn, will be discussed.

1.3 Psychological findings

1.3.1 Depression

Axis 1 clinical syndromes within the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) include unipolar depression - a disturbance characterised by prolonged negative affect, anhedonia, insomnia or hyposomnia and abnormal eating patterns (American Psychiatric Association [APA], 1994). Studies have consistently shown that serotonergic system impairment is implicated in the aetiology of major depressive disorder (McBride, Brown DeMeo, Keilp; 1994 Sheline, Bardgett, Jackson, & Newcomer, 1995). This has been demonstrated via neurochemical and neurological methods (McCann & Ricaurte, 1995). Hence, it is reasonable to assume that recurrent MDMA exposure results in the manifestation of depressive symptomology. The following psychological studies support this contention.

Parrott et al. (2002) tested 282 ecstasy users to explore the mental health deficits associated with recurrent MDMA intake. 109 novice users (1-9 occasions), 136 recreational users (10-99 occasions) and 36 heavy users (100 or more occasions) were administered the Symptom Checklist-90-Revised – an inventory which demonstrates high sensitivity in drug user populations (Derogatis, 1993). Subsequent Analysis of Variance (ANOVA) demonstrated significant between-group differences on measures of depression, anxiety and mood fluctuations, with negative affect increasing as a function of increased ecstasy consumption. However, as the mean T. Score for the novice user group signified mild dysthymia, the researchers concluded that even minimal MDMA exposure can be potentially neurotoxic (Parrot et al., 2002).

Other research studies have reported similar psychopathological reactions subsequent to ecstasy exposure. MacInnes, Handley, and Harding (2001) found a positive, linear correlation between ecstasy use and negative affect using the Beck Depression Inventory (1971). Chronic users exhibited levels of depression consistent with psychiatric patient norms. Likewise, in a large-scale research project conducted in the outpatient unit of a major European public hospital, 83% of ecstasy users presented with co-morbid psychological symptomology (Schifano et al., 1998). A majority of the sample were diagnosed with psychotic disorder, anxiety and clinical depression using DSM-IV structured interviews. Interestingly, the participants were adamant that these disorders were not pre-morbid (Schifano et al., 1998).

Similar findings have also been reported using experimental methods. To assess 5-HT neuronal function and levels of depression following MDMA exposure, Gerra et al. (1998) conducted a neuroendocrine challenge with a sample of 15 chronic ecstasy users. This involved the intravenous infusion of a serotonergic agonist to 'upregulate' the 5-HT system. Plasma prolactin and cortisol levels were subsequently measured radioimmunicologically as an indirect measure of cortical 5-HT activity. As expected, results showed that ecstasy users had significantly diminished levels of plasma prolactin in comparison to matched, ecstasy-naïve controls. 5-HT system impairment also correlated with higher indices of negative affect as measured by the Hamilton Depression Rating Scale (1960).

Therefore, psychological measures have revealed a relationship between ecstasy-induced neurotoxicity and depression. In fact, the literature cites several case studies concerning MDMA intake and the manifestation of suicidal ideation (Cohen, 1996). In several cases, subjects have proceeded to act on these suicidal urges due to extreme depressive states. Thus, the relationship between ecstasy use and depression is firmly established in the literature.

1.3.2 Anti-Social Behaviour

Anti-Social Personality Disorder is a condition characterised by a lack of conformity to social norms, aggression, irresponsibility, recklessness and a lack of remorse (APA, 1994). Although the disorder is an enduring pattern of behaviour, which manifests in childhood (APA, 1994), experts contend that chronic MDMA use can induce behaviours associated with APD (Gerra et al., 2001). This is perhaps because aggression and impulsivity are attenuated by 5-HT activity within the anterior hypothalamus, amygdala and posterior cortical regions (DeLeon, Grimes, Connor & Melloni, 2002; Dolan & Anderson, 2003). Several psychological studies have examined this relationship, with results affirming a relationship between anti-social behaviour and recurrent MDMA consumption.

In order to scrutinize developments in the illicit 'party drug' market, Longo, Humeniuk, Christie, Topp, and Ali (2001) employed the Illicit Drug Reporting System, which incorporates the statements of primary users as well as key informants. The study systematically reviewed the trends associated with

amphetamine analogue sale and consumption as well as the development of psychopathology among ecstasy users. Using DSM-IV structured interviews, the researchers found that paranoia, impulsivity and aggression were associated with prolonged ecstasy use. Moreover, anecdotal reports suggested that chronic MDMA users engaged in more public displays of aggression and overt hostility due to a lack of inhibitory control. In view of these findings, Longo et al. (2001) deduced that anti-social tendencies might be a result of ecstasy-induced neurotoxicity.

This contention has been further supported by neuropsychological research. Gerra et al. (2001) conducted a double-blind, control group study to assess the psychobiological effects of ecstasy exposure. The study involved a Monetary Subtraction paradigm to experimentally induce aggressive behaviour and to determine whether ecstasy users were more reactive, hostile and callous in comparison to controls. The results supported the research hypothesis, with ecstasy users exhibiting more pronounced anti-social tendencies and higher scores on the Buss Durkee Hostility Inventory (1957) and the Minnesota Multiphasic Personality Inventory (MMPI) psychopathic deviancy subscale. This type of responding negatively correlated with 5-HT system activity as evidenced by blunted neuroendocrine response.

Therefore, a correlation between anti-social tendencies and ecstasy consumption has been supported. One could infer that MDMA has pronounced effects on the serotonergic pathways that mediate aggression, fear response and emotional responsivity (Gerra et al., 2001).

1.3.3 Impulsivity

Eysenck (1977) provides an information-processing paradigm of impulsivity and low executive function. He posits that right hemispheric processes, which are sensitive to phonetic and visuo-spatial phenomena, process external stimuli. As a result, individuals who rate highly on tests of impulsivity are less dependent on left hemispheric semantic processing and are less analytical (Moeller et al., 2002). Alternative models of impulse control include the 'Low Reward/Delay hypothesis', where immediate gratification is favoured at the cost of a distant reward (Monterosso & Ainslie, 1999). This is related to an excessive sensitivity to stimuli associated with reward and a high threshold for punishment (Monterosso & Ainslie, 1999; Morgan, 1998). Researchers posit that 5-HT system impairment within the medial forebrain and lateral hypothalamus (the approach system) is implicated in this type of responding (Moeller et al., 2002). According to Shapiro "the regular executive apparatuses or generally operative modes of functioning are bypassed or broken through [in impulsive individuals]" (Shapiro, 1978, p.4).

Experts have claimed that impulsivity is symptomatic of MDMA exposure. Recreational ecstasy users habitually demonstrate executive function deficits as measured by neuropsychological tests (Dafters et al., 1999; Morgan, McFie, Fleetwood, & Robinson, 2002; Moeller et al., 2002). In a study by Morgan (1998), self-report and neuropsychological measures were used to assess the correlation between past ecstasy use and impulsivity. Sixty-four participants were recruited - 25 of whom constituted the ecstasy user group. The remaining

subjects were categorized as either polydrug users of alcohol and cannabis or non-drug user controls. The neuropsychological test battery included the Matching Familiar Figures Test (MFF20), the Tower of London and the Spatial Span Test to respectively assess impulsivity, executive planning and the 'visuo-spatial sketchpad' - a component of Baddeley and Hitch's (1994) Working Memory paradigm. Eysenck and Eysenck's (1991) Impulsiveness, Venturesomeness and Empathy Scale (IVE) was also administered.

Significant between-group differences were found, with the ecstasy user group exhibiting the highest impulsivity as measured by self-report data and MFF20. For the latter, response latency did not differ between groups. However, results showed substantial differences on the composite accuracy scores. Block, Block and Harrington (1974) posit that a reduction in the composite accuracy index for the MFF20 is symptomatic of cognitive impairment. Hence, Morgan (1998) provides compelling evidence that ecstasy use induces executive function deficits.

In a somewhat analogous study, Parrot et al. (2000) examined 28 non-dependent ecstasy users - 12 of whom were classified as 'heavy users' (10-100 occasions) and 16 'light users' (1-10 occasions). The IVE (Eysenck and Eysenck, 1991) was again administered to assess personality differences between groups. Consistent with Morgan's (1998) findings, impulsivity levels were significantly higher in the ecstasy user group. In fact, the construct demonstrated a continuous, linear relationship with ecstasy use, suggesting that impulsivity is exacerbated by repeated exposure.

Given the above findings, it is reasonable to assume that MDMA impacts upon the 5-HT pathways that innervate posterior executive processing regions. Thus, consumers of MDMA may be prone to executive function deficits, which may result in reduced forward planning ability and impulsive behaviour (Moeller et al., 2002).

1.3.4 Sensation seeking

Sensation seeking is characterized as "the need for varied, novel, and complex sensations and experiences and the willingness to take physical and social risks for the sake of such experiences" (Zuckerman, 1983, p.10). The construct is composed of four sub-factors, which are commonly perceived as normative developmental traits. These include boredom susceptibility, disinhibition, experience seeking and thrill and adventure seeking (Zuckerman, 1983). In this sense, sensation seeking is perceived as relatively 'non-pathological'.

The Noradrenalin-Depletion Hypothesis (Bardo, Donoghew, & Harrington, 1996) was developed to explain sensation seeking as a function of impaired catecholamine neuronal systems, in which the monoamines dopamine, noradrenalin and serotonin operate. Significant negative correlations have been found between high sensation seeking and deficiencies in CSF nor-adrenalin, dopamine and plasma Tryptamine Hydroxylase – the enzyme responsible for serotonin degradation (Schooler, Zahn, Murphy, & Buschbaum, 1978; Zuckerman, Ballenger, Jimerson, Murphy, & Post, 1984). Research has also

identified a sub-sensitivity of post-synaptic 5-HT receptors using radioligand SPECT analyses (Netter, Hennig, & Roed, 1996). Theoretically, therefore, elevated levels of sensation seeking may be partially related to MDMA-induced 5-HT neurotoxicity (Gerra et al., 2000). The following research findings support this theory.

To explore the relationship between sensation seeking and ecstasy use, Gerra et al. (2000) administered Cloninger's (1987) Tridimentional Personality Questionnaire (TPQ) to a sample of abstinent ecstasy users. As an adjunct, the researchers performed a neuroendocrine challenge three weeks and twelve months after MDMA discontinuation to assess the responsivity of 5-HT system. This was conducted using a serotonergic agonist (d-fenfluramine), which replicates the effects of serotonin at receptor sites. Results showed that plasma prolactin levels were significantly lower in comparison to controls. Interestingly, this impairment negatively correlated with higher levels of sensation seeking as measured by the TPQ subscale. Consequently, the authors suggested that sensation seeking is a result of ecstasy-induced neurotoxicity within localized 5-HT 1A clusters that mediate prolactin response and behavioural regulation (Gerra et al., 2000).

Similarly, Gouzoulis-Mayfrank et al. (2002) reported a significant linear correlation between sensation seeking and past MDMA use as measured by Zuckerman's (1979) Sensation Seeking Scale. In fact, statistical multiple regression analyses found that the construct was the most powerful predictor of ecstasy use followed by impulsivity and depression.

Hence, psychological evidence has indicated a relationship between sensation seeking and MDMA exposure (Gerra et al., 2000). This is particularly problematic as research has also revealed a correlation between sensation seeking and arousal of the Dorsal Noradrenergic Fibre Bundle and meso-limbic dopamine pathway - mechanisms which mediate high reward reinforcement (Bardo et al., 1996). Therefore, with prolonged exposure, ecstasy use may become a conditioned stimulus and viably a robust arouser.

1.3.5 Extraversion

A key feature of human personality is the construct 'extraversion' - a superordinate personality dimension comprising sociability, disinhibition, low harm avoidance, gregariousness and impulsivity (Costa & McCrae, 1992). Eysenck (1983) posits that extraverts require stimulation from the external environment due to low cortical arousal. Indeed, some researchers posit that facets of extraversion, particularly, impulsivity and inattentiveness, are the resultant effects of serotonergic system deficits within the posterior orbitofrontal cortex - a structure related to executive processing, disinhibition and extraverted responding (Blair & Cipilotti, 2002). Theoretically, therefore, heightened extraversion may be symptomatic of MDMA-induced 5-HT neurotoxicity within particular topographic regions. The following studies support this view.

Using Eysenck's (1979) Psychoticism, Extraversion and Neuroticism (PEN) paradigm and the MMPI, Villa, Saiz, Gonzalez, and Fernandez (1996) examined the psychobiological profiles of recurrent ecstasy users. The sample

was recruited from an outpatient rehabilitation service for stimulant abuse and comprised 27 adult ecstasy users as well 30 non-drug user, matched controls. Subsequent statistical regression analyses showed that extraversion and hypomania predicted chronic MDMA use. These findings were later replicated by Sanchez and Abella (1999) using the MMPI and the Kincannon Personality Questionnaire (1968) (KPQ).

Similar findings have been reported using neuropsychological methods. Zakzanis et al. (2002) assessed the cognitive and psychological characteristics of 24 chronic MDMA users via the Wechsler Abbreviated Scale of Intelligence (WASI), Costa and McCrae's NEO (1992) and the Test of Everyday Attention (TEA). Scores revealed that MDMA users performed worse on all cognitive attentional tasks although general intelligence levels were comparable between the groups. Correlational analyses also showed a significant relationship between attention deficits and higher scores on the NEO extraversion subscale.

As such, the relationship between MDMA exposure and extraversion is well established in the literature. Hence, consumers of MDMA may develop behaviours associated with extraverted responding such as inattentiveness and disinhibition. This may be a direct consequence of lowered cortical arousal due to due to serotonergic system impairment (Zakzanis et al., 2002).

1.3.6 Paranoia

Abnormal attributional processes are identifiable in major psychopathological disorders such as those involving paranoia (eg., paranoid

personality disorders, delusional disorder and paranoid schizophrenia) (Harper, 2003). Paranoid ideation is maintained by an idiosyncratic cognitive style whereby global, external, and stable attributions are made to explain negative social or personal events (Kinderman & Bentall, 1996). Some scholars suggest that this external locus of control is a method of attenuating self-blame, and therefore, anxiety (Kinderman & Bentall, 1997). Likewise, the construct is characterized by high trait arousability, in response to novel or unexpected stimuli, which results in 'harm-avoidance' behaviours (Mehrabian, 1995).

Clinical studies have attempted to establish a neuropsychological basis for this phenomenon. Kalivas, Sorg, and Hooks (1993) found adaptations in neural circuitry within the serotonergic and dopaminergic pathways of the midline limbic region in a sample of patients suffering paranoid hallucinatory psychosis. Such adaptations have been linked to decrements in sensorimotor gating, which leads to a 'startle' habituation response to relatively non-threatening environmental stimuli (Braff & Geyer, 1990; Vollenweider, Remensberger & Hell, 1999).

Paranoid ideation is also a consequence of long-term exposure to MDMA (Williamson, Gossop, Powis, Fountain, and Strang, 1997). Epidemiological surveys have shown that levels of psychosis and paranoid ideation amongst chronic MDMA users are generally comparable to psychiatric patient norms (John, Kwiatkowski, & Booth, 2001). In a sample of 158 chronic stimulant users, Williamson et al. (1997) employed structured DSM-1V interviews to assess the prevalence of psychopathology. The researchers found that ecstasy users

experienced paranoia and persecutory thoughts as a consequence of recurrent MDMA intake. Similarly, Parrot et al. (2002) demonstrated a positive correlation between MDMA consumption levels and paranoid ideation using the Symptom Checklist-90-Revised (Derogatis, 1993). Although results indicated that novice users demonstrated only minimal paranoia, chronic users manifested clinical levels of the construct, which bordered on paranoid psychosis.

Therefore, the link between paranoia and recurrent MDMA intake is supported by a wealth of empirical evidence. Paradoxically, however, there is some evidence to suggest that non-drug users demonstrate higher indices of paranoid ideation in comparison to recreational users who have not sustained pronounced neurological impairment (Parrot et al., 2002). Indeed, longitudinal research has shown that non-drug users generally manifest higher levels of pre-morbid paranoia than novice drug users (Block, Block & Keys, 1988; Brook, Whiteman, Shapiro, Cohen, & Balka, 1995). This ultimately results in 'harm avoidance' behaviours and a refusal to take drugs (Brook et al., 1995).

Theoretically, therefore, although there is an indisputable relationship between paranoid ideation and chronic MDMA exposure (Parrot et al., 2002; Williamson et al., 1997), this relationship may be curvilinear, with non-drug users and chronic drug users manifesting higher indices of the construct in comparison to recreational users.

1.4 Major methodological flaws in current psychological research

Although all of the aforementioned studies provide psychological evidence that MDMA induces long-term, neuronal changes, these conclusions are tenuous due to common methodological confounds and problems with sampling procedures.

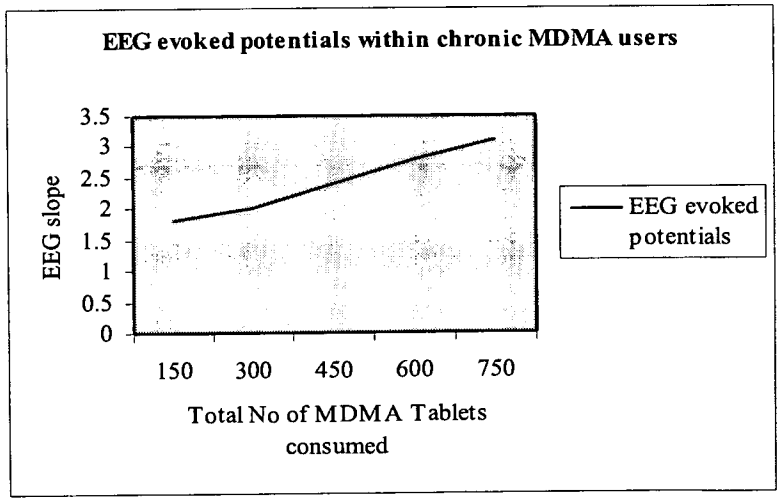
First and foremost, participants who consumed ecstasy tablets within several days of testing were not precluded from the investigations. Researchers have reported high rates of transitory depression, paranoia, impulsivity and aggression amongst ecstasy users experiencing a 'come down', several days after consumption (Curran & Travill, 1997; Parrot & Lasky, 1998). This appears to subside approximately after one week (Battaglia et al., 1988). Also, studies using radioligand SPECT analysis have shown impaired pre-synaptic serotonergic binding in recent MDMA users (Reneman et al., 2001). As this impairment is evident within cortical regions that mediate emotion and behaviour (Steele et al., 1994), the correlations reported in the current literature could be construed as an artefact of recent MDMA exposure. Thus, studies assessing permanent ecstasy-induced psychological changes must differentiate between subacute symptomology (greater than 24 hours and less than one week) and enduring psychological traits (Peroutka, Newman, & Harris, 1988).

Second, it is arguable that the correlations reported in the current literature are overestimated. This is because instruments such as the MMPI, the Tridimentional Personality Questionnaire (Cloninger, 1987) and the Sensation Seeking Scale (Zuckerman, 1979) include items relating to drug use and criminal

behaviour. Hence, the higher raw scores obtained by recreational drug users may be an artefact of drug-related illegal activity. For instance, MacAndrew (1979) proposes that anti-social behaviour and drug abuse are confounded due to mutual diagnostic criteria. Similarly, Arnett (1994) has commented that the TPQ and SSS typically over-estimate true levels of sensation seeking within drug user populations. Future analyses should preclude reference to drug use to develop a cohesive understanding of the relationship between MDMA and long-term psychological disturbances.

Third, and perhaps the most significant problem associated with current research, is the failure to control for polydrug use. This is problematic since alternative psycho-stimulant substances impact upon the 5-HT system in much the same way as MDMA (Ricaurte et al., 1989; Haney, Ward, Gerra and Foltin, 2001). Chemical analyses of amphetamine seizures have shown that the substance is now sold in the form of methamphetamine, a highly potent analogue of MDMA (Longo et al., 2001). Like ecstasy, the substance damages the ascending projections of the serotonergic system, which innervate the frontal lobes and cerebral cortex (Ricaurte et al., 1989). According to Longo et al. (2001), 70% of ecstasy users are polydrug users of methamphetamine and a small portion of these individuals co-administer both substances. This is also problematic as co-administration of MDMA and methamphetamine has been shown to increase the extent of 5-HT neurotoxicity (O'Loinsigh, Kelly, & O'Boyle, 2000). Thus, current research findings may not represent the psychological effects of MDMA, but rather the neurotoxic effects of a combination of psychoactive drugs.

Despite these methodological problems, research suggests that the neurotoxic effects of MDMA are cumulative (Gerra et al., 2000; Parrot et al., 2000; Parrot et al., 2002; Windhaber, Maeihofer, & Dantendorfer, 1998). That is, serotonergic system impairment becomes more pronounced as the composite dose of MDMA increases. These effects can be illustrated using an Ogive frequency curve as illustrated below. This data was adapted from the research findings of Croft, Klugman, Baldeweg and Gruzelier (2001) who found 5-HT dysfunction in the primary auditory cortex as measured by EEG evoked potentials. This dysfunction positively correlated with the level of MDMA consumed.



Therefore, although psychological and related research in this area demonstrate several problems, including

- a failure to control for recent MDMA exposure,
- a failure to employ effective diagnostic methods,
- a failure to control for polydrug use,
- a failure to control for co-administration,

it is still possible to hypothesize the main results.

Depression will increase as a function of ecstasy use, with those in the non-user category displaying lower indices of negative affect (McCann & Ricaurte, 1995). Likewise, anti-social traits will be incrementally higher as stimulant use increases (Gerra et al., 2001; Longo et al., 2001). Again, levels of this construct will be lowest in the non-user category. In accordance with psychobiological theories, sensation seeking will increase as a function of stimulant use (Gerra et al., 2000) as will impulsivity (Morgan, 1998) and extraversion (Zakzanis et al., 2002). Finally, however, a curvilinear distribution is expected for paranoia, with non-users and chronic users demonstrating higher scores than recreational users (Shekim et al, 2002).

These propositions are used in the next section to posit specific research hypotheses, followed by the description and justification of measures and subsequently, the appropriate analyses.

2.Method

2.1 Hypotheses

Based on the literature reviewed, the independent variables in the present study include the psychological constructs, depression, anti-social behaviour, sensation seeking, impulsivity, extraversion and paranoia. The dependent variables include non-use, 'recreational' ecstasy use and 'chronic' ecstasy use.

The null hypothesis for this study is that no differences exist between non-users, recreational users and chronic users of ecstasy. The research hypotheses for the study are as follows.

H1) There will be significant between-groups differences on measures of depression, with the trait increasing as a function of ecstasy use.

H2) There will be significant between-groups differences on measures of anti-social behaviour, with the trait increasing as a function of ecstasy use.

H3) There will be significant between-groups differences on measures of impulsivity, with the trait increasing as a function of ecstasy use.

H4) There will be significant between-groups differences on measures of sensation seeking, with the trait increasing as a function of ecstasy use.

H5) There will be significant between-groups differences on measures of extraversion, with the trait increasing as a function of ecstasy use.

H6) There will be significant between-groups differences on measures of paranoia, with higher indices of the trait manifesting in non-users and chronic users.

To test these hypotheses a series of one-way ANOVA's with planned comparisons will be performed along with a Discriminant Function Analysis to classify groups according to the six predictor variables.

2.2 Participants

A total of 120 individuals participated in this research study. 96 undergraduate and post-graduate students were recruited from the School of Education, the School of Communication, Information and New Media and the South Australian School of Art. The remaining participants were recruited from Warinilla clinic, a regional clinic of the Drug and Alcohol Services Council, the Woolshed Therapeutic Community in Ashbourne and several popular nightclubs in Adelaide. Overall, the response rate was 26%. The sample was comprised of 60.1% females and 39.9% males, with ages ranging from ages from 17 to 50 (M=23, SD=5.72). Subsequently, participants were allocated into a non-user group (N=76), a recreational ecstasy user group (N=23) and a chronic ecstasy/polydrug user group (N=21). Overall, the sample was 73.2% Australian, 19% European, 4.6% Asian and 3.2% Other.

Approval to conduct research was attained from several committees, including the Human Research Ethics Committee, Division of Education, Arts, and Social Sciences at the University of South Australia (Appendix A2) and the Executive Research Committee of the Drug as Alcohol Services Council (Appendix A3). All participants were informed that participation was voluntary and results would remain confidential.

2.3. *Measures*

2.3.1. *The drug use inventory*

Individual questionnaire forms contained a drug use index measuring ecstasy use. This was adapted from the National Drug Strategy Household Survey (AIHW, 2002) (Appendix B1). The index contained 8 questions referring to polydrug use, co- administration, time since last use, and the lifetime dose of MDMA. The participant was also asked to provide a qualitative statement describing any psychological disturbance suffered as a consequence MDMA exposure.

2.3.2 *The psychological test battery*

The psychological test battery comprised six likert self-rating scales for the assessment of the six constructs known to be related to central serotonergic function (Appendix B1). First, to quantify extraversion, a scale was extracted from Brebner's (2003) Quickscales Inventory - a condensed version of Costa and McCrae's (1992) five-factor personality inventory. The scale contains six composite items, with each containing three components, e.g. "How lively, outgoing, and extraverted are you?" Participants' scores range from 1 (not at all) through to 7 (extremely). This scale was selected due to adequate convergent, discriminant and predictive validity. In relation to reliability, Brebner (2003) reported an internal reliability coefficient of .8 and a test-retest co-efficient of .81. In the current study Cronbach's alpha was α=.87.

The Arnett Inventory of Sensation Seeking (1994) was selected to quantify sensation-seeking behaviour. The test contains 20 self-rating likert scales ranging from 1 (Does not describe me at all) through to 4 (Describes me very well) and includes items such as "I would like to travel to places that are strange and far away". In previous research, the test has yielded an internal reliability coefficient of .86 (Arnett, 1994). In the current study, Chronbach's alpha was .9. Unlike Cloninger's (1987) TPQ, the test precludes reference to drug use to control for confounding effects.

A four-item impulsivity scale, extracted from Grasmick, Tittle, Bursick, and Arneklev's (1993) Global Low Self Control Scale, was also employed. The scale contains four likert self-rating scales ranging from 1 (strongly disagree) through to 4 (strongly agree) and includes items such as "I often act on the spur of the moment". The aggregate scale has yielded an internal reliability coefficient of .8 (Grasmick et al., 1993). In the current study, Chronbach's alpha was .82.

Finally, standardized depression, anti-social personality and paranoia subscales from Morey's (1991) Personality Assessment Inventory (PAI) were selected due to high internal reliability, concurrent and predictive validity. In total, the three tests formed a 72-item scale, with each item ranging from 0 (false) through to 3 (very true). The items include statements such as "Much of the time I'm sad for no reason". In the current study, Chronbach alpha coefficients for the depression, anti-social personality and paranoia scales were, respectively, α=.94,

α=.79 and α=.9. Items referring to drug use and criminal behaviour in the PAI anti-social personality subscale were excluded in the statistical analysis.

Each questionnaire form was headed with standard instructions for the scales and additional items pertaining to demographic features such as gender, ethnicity and age.

2.4 Procedure

University student participants were approached during lectures and asked to participate in a research project investigating personality correlates of psycho-stimulant drug use. In accordance with ethical considerations, it was stated that participation was voluntary and anonymous and that data would remain confidential. It was emphasized that all data collection and reporting procedures would coincide with stipulations made in the Privacy Act (1988). Potential participants were also informed that the questionnaire would take approximately fifteen to twenty minutes to complete.

Due to the issue of anonymity, the researcher was not present to distribute the tests. Questionnaires and Information Sheets (Appendix B2) were left in lecture halls for potential participants to collect and complete. A box was left in the relevant school offices for completed questionnaire forms.

Given their age and the known epidemiology of stimulant use (AIWH, 2002), university students were a suitable population on which to test the hypotheses. However, because of relatively low base rates of chronic use,

subjects were recruited from several popular dance venues in Adelaide, which must remain anonymous for confidentiality purposes. Also, questionnaires were distributed to individuals attending the Warinilla clinic in Norwood for duty counselling or inpatient treatment as well as the Woolshed Therapeutic Community in Ashbourne.

At both the dance venues and rehabilitation centres, the staff distributed information sheets (Appendix B3) and questionnaires to potential participants along with reply-paid envelopes. All necessary information regarding anonymity and confidentiality was imparted as well as explicit instructions to complete the test subsequent to at least one week of abstinence. Overall, the duration of data collection was approximately four months.

Subsequently, participants were divided into appropriate groups for the statistical analysis. This was automated using the compute function in SPSS (v.11). Non-users were selected if they never used MDMA. Participants were classified as recreational users if they consumed less < 49 ecstasy tablets (Semple et al., 1999), were abstinent for at least one week (Battaglia et al., 1988) and if they did not report poly-drug use of psycho-stimulants (Ricaurte et al., 1989) or co-administration (O'Loinsigh et al., 2000). Therefore, although 56 recreational users were identified, only 23 were selected for the statistical analysis. Chronic users were selected if they used >50 ecstasy tablets and were abstinent for more than one week. Other exclusion criteria were not applied in order to retain a reasonable sample size in the chronic user group.

In order to convert raw scores to T. scores for the PAI subscales, a syntax file was created which automated this process. Descriptive and inferential procedures were conduced using SPSS (v.11) for Windows.

3. Results

3.1 Assumption testing

Prior to descriptive and inferential statistical procedures, the variables were reviewed to assess accuracy of entry, outliers, normality, multi-colinearity and homogeneity of variances. Normal distributions were assessed via histograms and tests of skewness and kurtosis. The results showed that age was positively skewed which violated the assumption of normality. However, this was anticipated since 'party-drug' use is a phenomenon that predominantly affects young adults. As 'age' was not included in any inferential procedures, internal validity was not influenced. The distributions for the continuous variables were positively skewed, precluding extroversion, which revealed a slight negative skew. Again, these violations of normality did not affect the multivariate analysis as the distributions were not extreme (.26 to -.33) (Francis, 2001).

Discriminant function procedures are particularly sensitive to violations of homogeneity of variances and multi-colinearity (Francis, 2001). Accordingly, Box's M was used to test the assumption of homogeneity of variances since the groups have unequal sample sizes. Box's M was not significant ($p>.06$), indicating that the dependent variables did not require transformation (Francis, 2001). Also, colinearity diagnostics were requested via multiple regression procedures. The tolerance figures were all above .3 for each continuous variable,

suggesting that the predictors were not interdependent (Tabachnick & Fidell, 1994).

3.2 Descriptive statistics and chi square analyses.

Descriptive statistical procedures were conducted to determine the mean number of times ecstasy had been used by recreational and chronic users. Recreational users consumed MDMA, on average, 14 (±6) times while chronic users consumed ecstasy, on average, 238 (±33) times.

Several Chi Square Tests of Independence were also conducted to determine patterns of alcohol, marijuana, amphetamine and cocaine use among the groups (see table 1). Similar analyses were performed to determine whether recreational and chronic users co-administer other psychoactive substances during ecstasy use (see table 2).

Table 1:
The percentage of non-users, recreational and chronic users who use alcohol, marijuana and the psycho-stimulants amphetamine and cocaine.

	Non-users % (N=76)	Recreational % (N=23)	Chronic % (N=21)	χ
Alcohol	92.1	100	100	6.1
Marijuana	42.1	100	100	61.2**
Amphetamine	2.6	0	95.2	139.2**
Cocaine	0	0	47.6	98.9**

Chi-Square analyses (df=2; two-tailed), $p<.01$*, $p<.001$**

Table 2:
The percentage of recreational and chronic users who co-administer other psycho-active substances while using MDMA.

	Recreational	Chronic	χ
Alcohol	87	100	2.9
Marijuana	69.6	90.5	2.9
Amphetamine	0	85.7	33.3**
Cocaine	0	57.1	18.1**
Heroin	0	4.8	1.1
Analgesics	4.3	14.2	1.3
Benzodiazepines	0	23.8	6.2*
Anti-depressant	0	33.3	9.1*

Chi-Square analyses (df=2; two-tailed), $p<.01$*, $p<.001$**

3.3 Bivariate Pearson Correlations

To determine the relationship between the independent variables, a Pearson Product Moment Correlation analysis was conducted. The bivariate intercorrelations for the independent variables are presented in table 3.

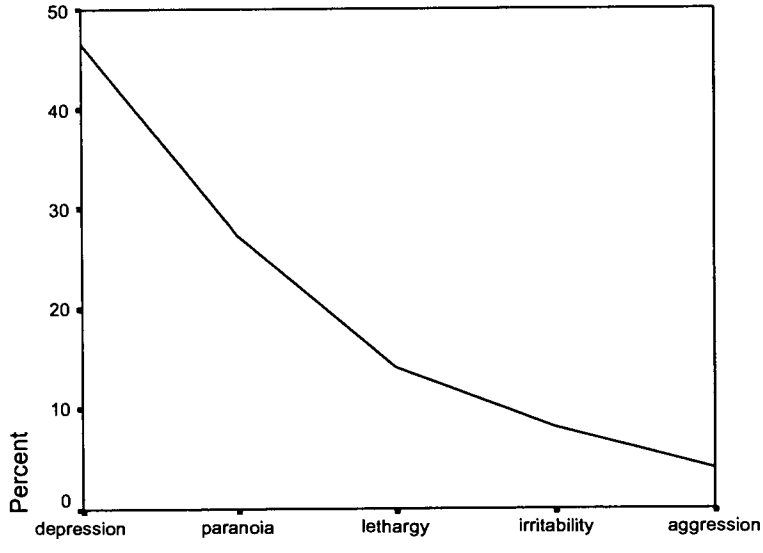
Table 3:
Bivariate correlations between the personality variables

	1	2	3	4	5
1.Depression	1.00				
2.Anti-social	.44**	1.00			
3.Paranoia	.78**	.57**	1.00		
4.SS	.25**	.56**	.25**	1.00	
5.Extroversion	.00	.47**	.01	.67**	1.00
6.Impulsivity	.28**	.56**	.26**	.80**	.61**

**.$p<0.01$ (2-tailed)

3.4 Content analysis

As an adjunct to inferential statistical procedures, a qualitative analysis was conducted to assess beliefs about enduring MDMA side effects. Using qualitative statements, 76% of the sample described one long-term psychological reaction they suffered as a consequence of MDMA intake. Responses were categorized by two independent raters. Five primary disturbances were identified, including depression, paranoia, lethargy, irritability and aggression. These disturbances were not significantly different between males and females. The frequencies for each response category are presented graphically (see below).



Psychological disturbances reported by users of MDMA

3.5 One-way Analysis of Variance with Planned Comparisons

A series of one-way ANOVA's with planned comparisons were conducted to distinguish between the groups by their scores on the psychological subscales. None of the demographic variables were entered as covariates as previous independent sample t.tests showed no significant gender or ethnicity

effects. Table 4 presents the means and standard deviations for the variables under examination and shows a progressive increase in psychopathology as drug use intensifies.

Given the cumulative effects of multiple planned comparisons on the error rate, Bonferroni's test was used to determine the alpha level required to avoid a type 1 error (Coakes & Steed, 2000). According to this test, each comparison needed to be evaluated against an alpha of p=.025.

Table 4:
Mean between-groups T. Scores for the depression, anti-social personality, paranoia subscales and raw scores for the extroversion, impulsivity and sensation seeking scales

	Non-users		Recreational		Chronic	
Variable	M	SD	M	SD	M	SD
1.Depression	56.6	13.8	66.1	11.7	69.7	6.2
2.Anti-social	48.4	10.7	58.7	1.9	64.7	11.2
3.Paranoia	54.6	12.4	60.1	11.1	61.2	15.2
4.SS	46.4	7.6	66.9	9.6	66.2	6.2
5.Extroversion	25.1	5.8	34.1	5.5	34.7	4.3
6.Impulsivity	7.9	1.8	12.0	1.9	15.0	1.1

3.5.1 Depression

Hypothesis one posits that there will be significant between-group differences on measures of depression, with the trait increasing as a function of stimulant use. The results of the one-way ANOVA for the depression subscale scores were significant, $F(2,117)=6.05$, $p<.003$. Planned comparisons with contrast analyses revealed that these differences were apparent between non-users

and recreational users t(117)=2.56, p=.012. Recreational users were also significantly different from chronic, t(117)=.42, p=.024.

3.5.2 Anti-Social Behaviour

Hypothesis two posits that there will be significant between-group differences on measures of anti-social behaviour, with the trait increasing as a function of ecstasy use. The ANOVA was highly significant, F(2,117)=23.6, p<.000. However, contrast analyses suggested that the difference was only apparent between non-users and recreational users t(117)=3.98, p<.01. No significant difference was reported between recreational and chronic users, t(117)=1.63, p=.14.

3.5.3 Impulsivity

Hypothesis three posits that there will be significant between-groups differences on measures of impulsivity, with the trait increasing as a function of stimulant use. The ANOVA for impulsivity was highly significant, F(2,117)=195.22, p<.000. Contrast analyses indicated that non-users were significantly different from recreational users, t(117)= 14.23, p<.000. Recreational users were also significantly different from chronic, t(117)=2.29, p=.023.

3.5.4 Sensation Seeking

Hypothesis four posits that there will be significant between-groups differences on measures of sensation seeking, with the trait increasing as a function of stimulant use. The ANOVA revealed a substantial F ratio, $F(2, 117)=111.236$, $p<.000$. A significant difference was found between non-users and recreational users, $t(117)=12.06$, $p<.000$ but not between recreational users and chronic users, $t(117)=.31$, $p=.75$.

3.5.5 Extraversion

Hypothesis five posits that there will be significant between-groups differences on measures of extraversion, with the construct increasing as a function of ecstasy use. The ANOVA for extraversion was highly significant $F(2, 117)=38.39$, $p<.000$. Contrast analyses indicated that non-users were significantly different from recreational users on this trait, $t(117)=7.64$, $p<.000$. Recreational users were not significantly different from chronic, $t(117)=1.21$, $p=.22$.

3.5.6 Paranoia

Hypothesis six posits that there will be significant between-group differences on measures of paranoia, with non-users and chronic users exhibiting higher indices of the trait. The ANOVA for paranoia revealed a significant F ratio, $F(2,117)=3.07$, $p=.005$. Interestingly, planned comparisons demonstrated a significant difference between non-users and recreational users $t(117)=1.4$, $p=.05$. This finding contradicted the research hypothesis. No significant difference was found between recreational users and chronic, $t(117)= .51$, $p=.55$.

3.6 Discriminant function analysis

In order to ascertain the relative importance of each criterion and to determine how well the six constructs predict and classify participants as 'non-users', 'recreational users' and 'chronic users' a Discriminant Function Analysis (DFA) was conducted. DFA is more robust to smaller sample sizes in comparison to ANOVA, which requires a group size of approximately 50 for adequate statistical power (Rosenthal & Rosnow, 1998).

3.6.1 Classification results

The results of the classification process using DFA were significant. The percentage of grouped cases correctly classified was 92.5% using the six variables (table 5). All of the non-users were correctly classified. Chronic users were next with an 81% chance of correct classification, followed by recreational users, 78.3%.

Table 5:
Classification of non-users, recreational and chronic users using Multiple Discriminant Function Analysis.

		Predicted Group Membership					
		Non-users		*Recreational*		*Chronic*	
Groups	N	%	n	%	n	%	n
Non-user	76	100	76	0	0	0	0
Recreational	23	13	3	78.3	18	8.7	2
Chronic	21	0	0	19	4	81	17
Percentage of grouped cases correctly classified: 92.5							

3.6.2 Canonical coefficient correlations with discriminant functions

Two discriminant functions were calculated, with a combined $x^2(17) = 213.8$, $p = .004$. The two functions accounted for 95.8% and 4.2% of the variance of the between group variability. Group centroid co-efficients indicated that the first discriminant function maximally separated non-users from recreational users while the second discriminant function maximally separated recreational users from chronic. Examination of the canonical coefficient correlations with each function shows that impulsivity, sensation seeking, depression and paranoia contribute most to function 1. APD and impulsivity contribute most to function 2. Therefore, the results support the ANOVA contrast analyses although DFA found anti-social behaviour to be a significant predictor of chronic ecstasy use. Canonical coefficients correlations with the two discriminant functions are presented in table 6.

Table 6:
Results of discriminant function analysis of the 6 personality variables used to predict group membership (non-users, recreational users and chronic users).

Correlations between canonical coefficients and discriminant functions		
Predictor variable	Function 1	Function 2
Impulsivity	.93**	.14*
Sensation Seeking	.66**	.53
Depression	.16**	.01
Paranoia	.13**	.08
Anti-social	.29	.42**
Extroversion	-.38	.49

$p<.01$*, $p<.001$**

4.Discussion

4.1Interpretation of the research findings

This research study set out to cross-validate existing theoretical assumptions concerning the relationship between MDMA-induced serotonergic neurotoxicity and long-term psychological changes. Indeed, a study of this nature was warranted since current research readily exhibits methodological flaws. Thus, by applying a priori selection criteria and rigorous sampling procedures, this study intended to delineate a more cohesive representation of this relationship. For all intents and purposes, this objective was achieved.

Although several extraneous variables were controlled, including recent MDMA exposure, co-administration, poly-drug use and problems with self-report inventories, the results nonetheless demonstrated a positive correlation between ecstasy use and long-term psychological disturbances (Gerra et al., 2001; McCann & Ricaurte, 1995; McInness et al., 2000; Morgan, 1998; Parrot et al., 2000; Parrot et al., 2002). Furthermore, in contrast to previous assertions (Croft et al., 2001), the current findings suggest that these changes may become apparent during the preliminary stages of ecstasy use. This was evidenced by the high indices of paranoia exhibited by recreational users despite the expected curvilinear distribution of scores. This finding was integral to the present study and was a cogent indication of the underlying neuronal changes which can occur subsequent to minimal MDMA exposure.

Moreover, this phenomenon was reflected in the ANOVA planned comparison and DFA results, which showed substantial differences between non-users and recreational users on all psychological measures (see table 6). The failure to detect pronounced changes beyond this point implies that neurotoxicity can manifest earlier than previously imagined.

4.2 The psychological effects of MDMA

In regards to depression, inferential analyses indicated that negative affect positively correlated with MDMA consumption levels. This was reflected by the substantial differences between non-users and recreational users and the significant differences between recreational and chronic (see table 4, 6). Clearly, the results are consistent with a vast body of research, which has demonstrated a relationship between MDMA intake and the manifestation of depressive symptomology (McCann et al., 1999; MacInnes et al., 2001; Parrot et al., 2002; Schifano et al., 1998). In fact, scores for the recreational user group signified pessimism and general sensitivity. However, the mean T. Score for the chronic group approached a level indicative of prominent dysphoria (Morey, 1991) (see table 4).

Results also indicated that behaviours associated with APD, a construct identified by unconventionality, impulsivity, recklessness and egocentricity (APA, 1994), may be a consequence of ecstasy use (Gerra et al., 2001; Longo et al., 2001). The mean subscale scores for both ecstasy user groups were significantly higher in comparison to controls. In fact, the mean T. Score for the chronic user group signified egocentrism and impulsivity, despite the preclusion

of items referring to drug use and illegal behaviour (Morey, 1991) (see table 4). As such, one could infer that ecstasy has an effect on the serotonergic pathways which mediate aggression, fear response and emotional processing (Gerra et al., 2001).

Similarly, current results demonstrated a strong correlation between ecstasy use and executive function deficits. Impulsivity, which is conceptualised as an excessive sensitivity to stimuli associated with reward and a high threshold for punishment (Eysenck, 1977), is typically related to information processing deficits and reduced forward planning ability (Dafters et al., 1999; Moeller et al., 2002; Morgan, 1998; Morgan et al., 2002). Given the results of the ANOVA and DFA, it seems that relatively low doses of MDMA, as found in the recreational user group, may have significant effects on high-density serotonergic transporter sites within posterior executive processing regions. These results support the findings of Parrot et al. (2002), who found high levels of impulsivity among 'novice' ecstasy users. Furthermore, the results of the ANOVA and DFA revealed that progressive use can exacerbate these cognitive, information-processing deficits (see table 4).

The current results also suggest that the construct sensation seeking is related to MDMA consumption. This conclusion corroborates the findings of Gerra et al. (2000) who demonstrated a negative correlation between impaired 5-HT1A pathways and sensation seeking in a sample of abstinent ecstasy users. Thus, MDMA intake may have pronounced neuro-psychological side effects and may lead to a greater reliance on thrill seeking and high risk behaviours for

psychological stimulation and reinforcement (Gouzoulis-Mayfrank et al., 2002; Netter et al., 1996).

As far as extraversion is concerned, results verify the assumption that heightened levels of extraversion can result from MDMA use. This conclusion supports the findings of both Villa et al. (1996) and Zakzanis et al. (2002) who reported a positive correlation between ecstasy use and extraverted behaviour. From a neuropsychological perspective, it is feasible that ecstasy-induced neurotoxicity affects the orbitofrontal cortex within the midline limbic area – a structure implicated in executive processing, disinhibition and extraverted responding (Blair & Cipilotti, 2002).

Finally, recreational users attained higher scores on the paranoia subscale than non-users. Indeed, the T. Scores obtained indicated the presence of sensitivity and scepticism in interpersonal relationships (Morey, 1991). This finding was quite unexpected, given the hypothesized curvilinear distribution of scores and the findings of both cross-sectional and longitudinal research (Brook et al., 1995; Parrot et al., 2002). As previously discussed, this finding was integral to the current study, and suggested that neuronal adaptations can occur during preliminary stages of use. Therefore, by testing a construct which does not demonstrate a continuous, linear correlation with ecstasy use, there is greater evidence that MDMA exposure can have an effect on pre-existing psychological states.

Taken together, the results of the present study suggest that depression, APD, impulsivity, sensation seeking, extraversion and paranoia may be a consequence of 5-HT neurotoxicity subsequent to minimal MDMA exposure. Disturbingly, these constructs collectively form the basis of Eysenck's super-ordinate Psychoticism factor (Joireman, Anderson & Strathman, 2003). The results of the bivariate Pearson correlations are particularly supportive of this view (see table 3). In this light, it is reasonable to conclude that consumers of MDMA may develop behaviours associated with extreme psychopathology due to functional, neuronal changes.

Patently, these findings provide a cogent argument for potential consumers to make an informed decision about ecstasy consumption (see table 6). This finding is of paramount importance since researchers have recently begun to discern abnormal patterns of use among consumers. Bingeing is commonly defined as 'using large amounts of a substance over several days' and has become a common occurrence among 'party-drug' users (Gowing, Henry-Edwards, Irvine, & Ali, 2001). Pre-clinical pharmacology studies have shown that by flooding the synaptic cleft for a prolonged duration, the ascending projections of the dorsal raphe nuclei sustain profound damage (Fox & Parrot, 2003; MacInness et al., 2001). Given that the current study found pronounced psychological changes subsequent to relatively low doses of MDMA, it is arguable that bingeing can lead to greater cognitive and psychological deficits (Topp et al., 1999).

4.3 Strengths and weaknesses

Perhaps the most problematic issue with this area of research, is the argument that psychopathology is merely reflective of a pre-existing condition (Cole & Sumnall, 2003). In fact, several studies have found that impulsivity, APD and depression pre-dispose individuals to stimulant drug abuse (Khantzian, 1985; Hawke, Jainchill, & De Leon, 2000). Thus, such constructs have been viewed as aetiological factors rather than resultant effects. Although this study is prone to the same interpretative difficulties, the distribution of scores found for the paranoia subscale indicate that pronounced psychological changes do indeed occur (Brook et al., 1995). This conclusion is further supported by the bivariate Pearson correlation results (see table 3). Hence, although there is a possibility that these disorders exist pre-morbidly, current results suggest that this is unlikely.

Furthermore, this research study was designed to assess long-term psychological changes through a more direct method. As an adjunct to the self-report inventories, participants were asked to provide a qualitative statement describing any psychological deficits endured as a result of MDMA exposure. 76% of participants purported to have suffered at least one long-term disturbance. These included depression, paranoia, lethargy, irritability and aggression. Indeed, these statements coincided with the results of the inferential analyses - providing greater evidence of psychological disturbance. As such, one is able to conclude, with greater confidence, that MDMA exposure does impact on existing psychological states and is thus neurotoxic. In any case, the inclusion of formal

differential diagnoses may be required in future analyses to verify whether these disturbances exist pre-morbidly.

Despite the many procedural advantages associated with the present study, several weaknesses were evident. Despite best attempts to control for polydrug use in the recreational user group, it was impossible to control for alcohol and cannabis (see table 1). Although these substances are not specifically 5-HT neurotoxins (Croft et al., 2001), some research has shown that the residual effects of cannabis include mild depressive symptomology and paranoid ideation (Reilly, Didcott, Swift and Hall, 1998). Accordingly, it is reasonable to assume that these psychoactive substances impacted on the results. Thus, although the present study provides support for the 'MDMA-neurotoxicity' hypothesis, results are not entirely without flaw.

Similarly, non-parametric analyses demonstrated an increase in the levels of poly-drug use and co-administration associated with 'chronic' MDMA consumption (see table 1, 2). In fact, participants purported to use amphetamines, cocaine, heroin, anti-depressants and benzodiazepines. This 'cocktail' of drugs represents a major methodological confound. Indeed, the elevated impulsivity, depression and APD levels (see table 4) may be construed as an artefact of methamphetamine or cocaine-induced neurotoxicity (Haney et al., 2000; Ricaurte et al., 1989).

Furthermore, 'street drugs' such as ecstasy, have been found to contain differential levels of MDMA, epinephrine, amphetamine and ketamine (Saunders

et al., 1995; Wolff, Hay, Sherlock, & Conner, 1995). Although research claims that ecstasy tablets sold in Australia contain between 70 and 85mg of MDMA (Gowing, 2001), there is currently no process by which to identify the exact composite amount of MDMA consumed. Indeed, chemical analyses suggest that some ecstasy tablets, sold under the guise of MDMA, actually contain Paramethoxyamphetamine (PMA), a potentially lethal and neurotoxic analogue (Felgate, Felgate, James, Sims, & Vozzo, 1998). Conversely, some research has indicated that street ecstasy may not contain MDMA at all (Ditton et al., 2000). In truth, this extraneous variable has posed a major problem for all MDMA research conducted outside of a clinical context (Cole & Sumnall, 2003).

Moreover, despite several months of data collection, the sample sizes in the current study were comparatively small. In relation to statistical power and effect size, this is a major criticism. Although discriminant function analyses are quite robust to limited group sizes, ANOVA's require approximately 50 per group for robust statistical power (Tabachnick & Fidell, 1994). Therefore, despite best efforts to acquire a maximum number of participants, the criteria applied in the current study required that a substantial portion of recreational users be excluded. As such, the results require cross-validation. For future purposes, more intensive data collection procedures should be implemented to attain an optimal number of participants and thus increase statistical power and effect size.

4.4 Conclusions and implications

Although this investigation was subject to several methodological flaws, it was able to replicate the results of many previous research studies whilst controlling for several extraneous variables. Moreover, these findings provide further evidence that psychological disturbances are functional indices of MDMA-induced serotonergic damage.

In accordance with these findings, there is a pressing need for the development and dissemination of an effective primary prevention strategy. Current diversion programs practiced in the Australian educational system commonly rely on the provision of factual information (Munro & Midford, 2000). Paradoxically, such 'fear tactics' have been shown to increase adolescent drug use by stimulating curiosity (Burgess, 1997). As such, an evidence-based and soundly conceptualised Cognitive-Behavioural program may be required to reduce drug-taking behaviour by targeting psychosocial and intra-personal dynamic risk factors (Botvin et al., 2002). This approach may be used in conjunction with 'harm minimisation', a fundamental component of the National Drug Strategic Framework (Ministerial Council on Drugs, 1998). This approach delineates ways to practice 'safer' drug taking to reduce the risk of potential fatalities. Common practice includes avoiding polydrug use, co-administration, binge patterns and learning how to deal with a prospective overdose (Bammer, Hall, Hamilton, & Ali, 2002). In an educational context, this combined approach may facilitate the goals of primary prevention and harm minimisation (Munro & Midford, 2000).

In conclusion, there is a pressing need for individuals to recognise the potential psychological complications that can result from recreational ecstasy use. Accordingly, experts should recognise the need for an effective, evidence-based education strategy in order to stem the tide of MDMA-induced mental health deficits in the community.

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APPENDICES

Appendix A

Correspondence

17 March 2003

Ms Lisa Irvine
C/- Mr Stuart Byrne
Lecturer Clinical Forensic Psychology
School of Psychology
University of South Australia
City East Campus

Dear Ms Irvine

I refer to your request of 11 March 2003 for approval to survey, via questionnaire, 250 undergraduate students in the schools of Communication, Information and New Media, Education and Art to gain some understanding of the *personality constructs associated with recreational psycholstimulant drug use.*

I have canvassed this with the relevant Heads of School who have confirmed that they have no objection to the study. On this basis, approval is granted, subject to approval by the Human Resource Ethic Committee.

I wish you every success with your study.

Yours sincerely

Professor Michael Rowan
Pro Vice Chancellor and Vice President
Division of Education, Arts and Social Sciences

cc: Professor Marie Brennan, Head of School and Dean, Education
Mr David Homer, acting Head of School, Communication, Information and New Media
Professor Kay Lawrence, Head of the South Australian School of Art

GPO Box 2471
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Australia

Telephone: 8302 4420
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Dear Lisa

Re: Ethics Protocol P065/03 "Personality constructs associated with recreational, psychostimulant drug use".

Thank you for providing the amendments and/or additional information requested by the Human Research Ethics Committee (letter dated 11 April 2003). The Acting Chair of HREC has considered your response together with your request to broaden the participation of the study to include chronic drug users from a treatment centre such as Waranilla.

Your responses to points 1 and 2 in the HREC letter mentioned above have been approved. In relation to point 3, the Acting Chair (Ms Josie Luscri) has suggested that you provide an envelope (for completed questionnaires) to all participants from Waranilla, especially if you collect the questionnaires personally. In relation to your response to point 4, the Acting Chair considers that 20 minutes to complete the questionnaire will be insufficient. Ms Luscri will contact you to discuss points 3 and 4 and your responses.

However, please note that your protocol has been approved but you are requested to discuss your responses to points 3 and 4 of the HREC letter with the Acting Chair, Ms Josie Luscri (School of Psychology, City East Campus).

Please regard this email as formal notification of approval.

Ethics approval is always made on the basis of a number of conditions detailed in the attachment; it is important that you are familiar with, and abide by, these conditions. It is also essential that you conduct all research according to UniSA guidelines, which can be found at <http://www.unisa.edu.au/orc/ethics/index.htm>.

Best wishes for your research.

Regards, Vicki

Conditions.May2001 (2).doc

Vicki Allen
Ethics Officer
Research Services
University of South Australia
Mawson Lakes Campus
Mawson Lakes Boulevard
Mawson Lakes SA 5095
Telephone: + 61 8 8302 3118

3 October, 2003

Lisa Irvine
3 Kooralla Grove
Kidman Park
SA 5025

Dear Lisa,

Re: Research Application: Personality traits associated with recreational psycho-stimulant drug use

I am pleased to advise you that your request to access problem stimulant users through Drug and Alcohol Services Council (DASC) treatment facilities has been approved by the Clinical Executive Committee.

Please ensure that we receive a copy for our records of the letter of approval from the ethics committee of the University of South Australia, when approval is granted. We also request that you forward copies of any reports or papers that you produce based on your research involving DASC clients, for inclusion in the DASC Library.

If you have any further queries regarding this approval, please feel free to contact me. For any queries regarding DASC clinic issues including participant recruitment, I suggest contacting Toni Hendry at Warinilla in the first instance (Tel. 8130 7521)

I wish you all the best with your research project.

Yours sincerely,

Mr Paul Christie
Senior Research Officer

christie.paul@saugov.sa.gov.au
Tel. 8274 3369

Appendix B

Questionnaires

Information Sheets

The Personality Assessment Inventory
(Morey, 1991)

Please indicate your responses on the answer sheet provided. Indicate which response best applies to you. Your choices are *False, Slightly True, Mainly True and Very True.*

1) Much of the time I'm sad for no reason.

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

2) Most of the people I know can be trusted.

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

3) I was usually well-behaved at school

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

4) I feel that I've let everyone down

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

5) Certain people go out of their way to bother me

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

6) I've borrowed money knowing I wouldn't pay it back

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

7) I hardly have any energy

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

8) People usually treat me pretty fairly

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

9) I get a kick out of doing dangerous things

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

10) I've forgotten what it's like to be happy

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

11) I have to be alert to the possibility that people will be unfaithful

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

12) I've deliberately damaged someone's property

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

13) Sometimes I think I'm worthless

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

14) Some people do things to make me look bad

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

15) I'll take advantage of others if they leave themselves open to it

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

16) I have no trouble falling asleep

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

17) I seem to have as much luck in life as others do

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

18) I do a lot of wild things just for the thrill of it

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

19) Everything seems like a big effort

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

20) Most people have good intentions

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

21) I've done some things that weren't exactly legal

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

22) I don't feel like trying anymore

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

23) People around me are faithful to me

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

24) I'll do most things if the price is right

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

25) I rarely have trouble sleeping

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

26) I've given a lot, but I haven't gotten much in return

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

27) My behaviour is pretty wild at times

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

28) Nothing seems to give me much pleasure

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

29) I usually assume people are telling the truth

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

30) I used to lie a lot to get out of tight situations

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

31) I can't seem to concentrate very well

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

32) Some people try to keep me from getting ahead

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

33) I can talk my way out of just about anything

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

34) I've been moving more slowly than usual

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

35) People don't appreciate what I've done for them

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

36) If I get tired of a place, I just pick up and leave

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

37) I've lost interest in things I used to enjoy

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

38) People generally hide their real motives

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

39) I like to see how much I can get away with

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

40) No matter what I do, nothing works

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

41) There are people who want to hurt me

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

42) I don't like being tied to one person

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

43) I often wake up very early in the morning and can't get back to sleep

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

44) I've usually gotten credit for what I've done

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

45) The idea of "settling down" has never appealed to me

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

46) I have no interest in life

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

47) People think I'm too suspicious

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

48) I was never expelled or suspended from school when I was young

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

49) I think good things will happen to me in the future

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

50) People seldom treat me badly on purpose

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

51) I don't like to stay in a relationship very long

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

52) I have a good appetite

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

53) People who are successful generally earned their success

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

54) I like to drive fast

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

55) Lately I've been happy much of the time

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

56) Things are rarely as they seem on the surface

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

57) I've never been in trouble with the law

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

58) I have something worthwhile to contribute

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

59) People have had it in for me

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

60) I look after myself first; let others take care of themselves

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

61) I often wake up in the middle of the night

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

62) I'm not the type of person to hold a grudge

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

63) I'm not a person who turns down a dare

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

64) I'm almost always a happy and positive person

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

65) People have to earn my trust

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

66) I've never taken money or property that wasn't mine

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

67) I'm pretty successful at what I do

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

68) I'm the target of a conspiracy

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

69) When I make a promise, I really don't need to keep it

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

70) I have little interest in sex

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

71) Being helpful to other people pays off in the end

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

72) I never take risks if I can avoid it

False ☐ Slightly True ☐ Mainly True ☐ Very True ☐

For each item, indicate which response best applies to you by circling the appropriate letter.

1 - Does not describe me at all
2 - Does not describe me very well
3 - Describes me somewhat well
4 - Describes me very well

1. I can see how it would be interesting to marry someone from a foreign country. _____

2. When the water is very cold, I prefer not to swim even if it is a hot day. _____

3. If I have to wait in a long line, I am usually patient about it. _____

4. When I listen to music, I like it to be loud. _____

5. When taking a trip, I think it is best to make as few plans as possible and just take it as it comes. _____

6. I stay away from movies that are said to be frightening or highly suspenseful. _____

7. I think it's fun and exciting to perform or speak before a group. _____

8. If I were to go to an amusement park, I would prefer to ride the rollercoaster or other fast rides. _____

9. I would like to travel to places that are strange and far away. _____

10. I would never like to gamble with money, even if I could afford it. _____

11. I would have enjoyed being one of the first explorers of an unknown land. _____

12. I like a movie where there are a lot of explosions and car chases. _____

13. I don't' like extremely hot and spicy foods. _____

14. In general, I work better when I'm under pressure. _____

15. I often like to have the radio or TV on while I'm doing something else, such as reading or cleaning up. _____

16. It would be interesting to see a car accident happen. _____

17. I think it's best to order something familiar when eating in a restaurant. _____

18. I like the feeling of standing next to the edge on a high place and looking down. _____

19. If it were possible to visit another planet or the moon for free, I would be among the first in line to sign up. _____

20. I can see how it must be exciting to be in a battle during a war. _____

Please answer each question by using the appropriate scale.

Choose the response which is closest to your usual feelings or behaviour.

1. Not at all
2. Slightly
3. Less than most
4. Moderately
5. More than most
6. Very much so
7. Extremely

1. How lively, outgoing, and extraverted are you? _____
2. How much do you prefer meeting people rather than reading, studying, or being at home? _____
3. How sociable, friendly, and relaxed are you with other people? _____
4. How active, quick and responsive are you? _____
5. How easily can you tell jokes, or give your opinion, when you are the centre of attention? _____
6. How much do you like being at large, noisy parties with lots of people you have never met? _____

Choose the response which is closest to your usual feelings or behaviour.

1. Strongly disagree
2. Disagree somewhat
3. Agree somewhat
4. Strongly agree

1. I often act on the spur of the moment. _____
2. I don't devote much thought and effort to preparing for the future. _____
3. I often do whatever brings me pleasure here and now, even at the cost of some distant goal. _____
4. I'm more concerned about what happens to me in the short run than in the long run. _____

Drug Use Inventory
Adapted from the National Drug Strategy Household Survey
(Australian Institute of Health and Welfare, 2002)

1. Have you ever used alcohol?

Yes ☐ No ☐

2. Have you ever used Cannabis?

Yes ☐ No ☐

3. Have you ever used MDMA/Ecstasy? (Adam, E's, Ecci's)

Yes ☐ No ☐

4. Please estimate the number of times you have used Ecstasy in your lifetime. _____

5. How long ago did you last use Ecstasy? _____

6. When you have used Ecstasy, what other substances have you used at the same time?

Amphetamine ☐ Alcohol ☐ Cocaine ☐ Benzodiazepines ☐

Cannabis ☐ Analgesics ☐ Heroin ☐ Anti-depressants ☐

7. Have you used other forms of psycho-stimulant drugs for non-medical purposes?

Amphetamine ☐ Cocaine ☐ None ☐

8. In the space provided, briefly describe any lasting psychological or emotional problem you believe you have suffered as a result of your ecstasy use. Please do not refer to temporary symptoms associated with the 'come down' period.

_____

_____

17th March, 2003

Honours project: Personality characteristics associated with recreational, psycho-stimulant drug use.

Researcher: Lisa Irvine, B.Psych,; Supervisors: Stuart Bryne and Dr Phil Mohr, School of Psychology, University of South Australia.

My name is Lisa Irvine and I am a fourth year Honours student with the School of Psychology at the University of South Australia. I invite you to participate in the following research study.

The objective of this project is to understand the personality traits associated with recreational psycho-stimulant drug use. As a participant, you will be invited to complete several personality tests and a questionnaire derived from the National Drug Strategy Household Survey (1998). This will explore levels of psycho-stimulant drug use. These questionnaires should take approximately 20 minutes to complete.

Participation in this study is strictly voluntary and you may cease involvement at any time. Please note that you will not be asked to provide any personal details and your results will remain completely confidential. No one, other than the researcher and supervisor, will have access to the data. Also, you will be asked to place completed questionnaires in boxes provided in your school office. These procedures will ensure total anonymity. Also, in compliance with principles contained in the Privacy Act (1988), all information collected as part of the study will be retained for seven years by the School of Psychology at the University of South Australia.

For those among you who become concerned about a drug related problem, agencies such as the Drug and Alcohol Services Council provide 24 hour confidential telephone counselling. The telephone number for this support service is 1300 131 340.

The Human Research Ethics Committee, of the University of South Australia, has reviewed this study. Any specific concerns regarding the project may be discussed with Vicki Allen, Executive Officer of the Human Research Ethics Committee. Ph No. (08) 830 23118.

Kindest regards,

Lisa Elizabeth Irvine

11th May, 2003

Honours project: Personality characteristics associated with recreational, psycho-stimulant drug use.

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Participation in this study is strictly voluntary and you may cease involvement at any time. Please note that you will not be asked to provide any personal details and your results will remain completely confidential.

The researcher will distribute and collect the questionnaires. Alternatively, a reply-paid envelope will be provided so that completed surveys may be returned to the School of Psychology. However, no one, other than the researcher and supervisor, will have access to the data. These procedures will ensure total anonymity. Also, in compliance with principles contained in the Privacy Act (1988), all information collected as part of the study will be retained for seven years by the School of Psychology at the University of South Australia.

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Kindest regards,

Lisa Elizabeth Irvine

Stuart Byrne - Supervisor
Ph No. 8302 2470