

Project Number: 50-DVG-5642

ALL ABOUT "E": A COMPILATION OF ECSTASY FACTS

An Interactive Qualifying Project Report

submitted to the Faculty

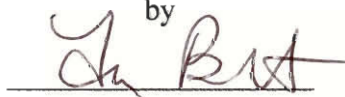
of the

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for the

Degree of Bachelor of Science

by

A handwritten signature in black ink, appearing to read "Tina Bramante", is written over a horizontal line.

Tina Bramante

Date: May 6, 2004

Professor Daniel Gibson, Major Advisor

1. Ecstasy
2. MDMA

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Preface

The purpose of this report is to present a collection of facts and current research about MDMA, the drug known as Ecstasy. It is addressed to readers who have minimal prior knowledge about MDMA and it attempts to give the reader a broad sense of the drug's history, risks, chemistry, and effects. This paper is intended for use as an educational guidebook about various aspects of Ecstasy use.

Acknowledgments

I would like to thank Dr. Daniel Gibson for his interminable patience and his unwavering faith that this project would eventually come to an end. Also, thanks to the Massachusetts General Hospital for giving me access to their extensive resources. Thank you to the 829 WPI students who took the time to fill out my survey and to Mail Services for getting those 829 little slips of paper back to me. My mom deserves thanks for stuffing half of the 3,000 student mailboxes and helping with half of just about everything else I do. Lastly, I would like to thank Dan once more for never giving up on me... I'll never look at horseshoe crabs the same way again.

Abstract

This project consisted of a survey, paper, and pamphlet about MDMA, the drug known as Ecstasy. A confidential survey of WPI students was conducted to determine the need for an informational pamphlet. The survey found that 7.7% of students had tried Ecstasy. The paper was created as an in-depth compilation of current information about Ecstasy. Pertinent information from the paper was simplified to create an educational pamphlet about the drug for use at high schools and colleges.

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Introduction

The drug Ecstasy has been the center of a firestorm of confusion, controversy, and scandal. Ecstasy is the common name for the chemical methylenedioxyamphetamine (MDMA) and the names will be used interchangeably in this paper. Bursting onto the recreational drug scene in the early '80s, Ecstasy use has increased dramatically, gaining tremendous media attention. Ecstasy is different from other recreational drugs because a number of therapists and professionals advocate the drug's psychotherapeutic uses. Severe scheduling of the drug by the DEA caused uproar with advocates, but even more outrageous were the dubious results of federally funded studies indicating that Ecstasy causes Parkinson's disease. The studies, conducted by Dr. George Ricaurte, were published and later retracted in the journal *Science*. Public pressure has spurred the government to allow a new study of the drug in humans as a treatment for Post-Traumatic Stress Disorder. The landscape of Ecstasy use, knowledge, and legality has been changing over the past 30 years and continues to evolve.

The purpose of this project was to compile current research on Ecstasy from a variety of sources, including medical journals, news articles, books, television, and a small survey. The information presented in this paper is intended to give the reader a clear understanding of the history, chemistry, usage patterns, experience, current research, and risks of Ecstasy. An educational pamphlet of select, important information will be created from the contents of this paper. This project was created with the belief that an educated consumer is a safer consumer.

History

The German chemical company Merck first synthesized MDMA in 1912 and patented it two years later, on Christmas Eve of 1914 (Saunders 1996). It is believed that the drug was synthesized as a potential psychotherapeutic agent or as the precursor to one (Cohen 1998). Throughout the following decades, military organizations experimented with the drug, but to no avail. The earliest example occurred during WWI, when MDMA may briefly have been given to German soldiers as an experimental appetite suppressant. Although the accuracy of this statement has never been verified, the experiment was most likely short-lived because the empathy-inducing effects of the drug would have been disadvantageous for soldiers (Holland 2001). Military interest in the drug re-emerged in the 1950s, when the US Army conducted experiments on animals to investigate MDMA and other MDA analogues as possible agents of chemical warfare. Again, these experiments on MDMA proved fruitless (Saunders 1996). In a military study conducted in the early 1990s, MDMA was used during therapy sessions with Nicaraguan soldiers. The result was that 75% of those soldiers reported a strong urge for peace and a desire to love everyone, even the enemy. The drug was again abandoned for use in a military setting because of its empathy-inducing qualities (Holland 2001).

Alexander Shulgin, a biochemist for Dow Chemical Company who researched psychedelics on the side, rediscovered MDMA in the late 1960s (Holland 2001). In 1976, medical journals began publishing articles on the therapeutic effects of MDMA, which was being used in psychotherapy and marriage counseling. Author Simon Reynolds is quoted as saying, "Advocates claimed that a five hour MDMA trip could

help the patient work through emotional blockages that would otherwise have taken five months of weekly sessions,” (Holland 2001).

During the early 1980s, people had begun using MDMA recreationally, beginning in Dallas and Austin, Texas nightclubs. By 1983, a full-fledged MDMA party scene had emerged (Holland 2001). The DEA (Drug Enforcement Agency) found that, through the end of the 1980s, nearly all of the MDMA being sold on the street was of high purity (Beck and Rosenbaum 1994). It was during the early 1980s Texas-MDMA scene that a ‘high-level’ dealer of the drug began calling it “Ecstasy” in order to boost sales and interest more people in trying it. Therapists felt that the street nickname “Ecstasy” was unfortunate because it did not accurately describe the therapeutic experience. Since many patients who underwent MDMA therapy were attempting to cope with serious trauma, such as a rape, their therapeutic experience could hardly be described as “ecstatic”. For these patients, MDMA lessened fear and increased acceptance of painful and/or repressed memories but it did not necessarily induce euphoric feelings. To their dismay, the nickname brought intense government scrutiny to the drug and likely contributed to its eventual legal demise (Beck and Rosenbaum 1994).

In response to the explosion of recreational Ecstasy use, Congress passed a law allowing the DEA to put an emergency ban on any drug that it deemed potentially dangerous. The law was applied for the first time on July 1, 1985 to ban MDMA. Since the emergency ban would last only one year, the DEA held a hearing to establish a more permanent ban. The judge recommended that MDMA be placed in the less restrictive Schedule III category. The DEA disagreed and placed the drug permanently in the most

restrictive category, Schedule I, on November 13, 1986 (Saunders 1996, Beck and Rosenbaum 1994). The DEA describes Schedule I drugs as being available only for use in highly restricted research and having no approved medical use. Schedule II drugs require a non-refillable prescription and special release forms. The DEA considers Schedule I and II drugs have a high potential for abuse National Institute on Drug Abuse (NIDA) (NIDA Website).

Table I. DEA Schedule of Commonly Misused Controlled Drugs (NIDA Website).

DEA Schedule	Type of Drug
I	Marijuana, GHB, Methaqualone (Quaalude), PCP, LSD, Mescaline, Psilocybin (“magic mushrooms”), Fentanyl, Heroin, MDMA
II	Barbiturates, Codeine, Morphine, Opium, Amphetamine, Cocaine, Methamphetamine (crystal meth), Methylphenidate (Ritalin), Anabolic Steroids
III	Ketamine

Alarmed by the sudden and severe scheduling, therapists who believe strongly in the drugs therapeutic potential appealed the DEA’s scheduling decision. They testified that the drug enhanced communication, reduced fear, improved understanding, and increased empathy, making it valuable for therapy. Many of the therapists cited an unpublished study of 21 patients who received MDMA one time during therapy. The patients were evaluated using blood chemistry, neurological examinations, and physiological measures and, after three months of follow-up, were free of clinically apparent toxicity.

The same study also noted that the effects of the drug appeared to be transient and were highly predictable (Beck and Rosenbaum 1994). Advocates also noted that, though

animal studies can be used to observe physical effects, human trials must be done to observe psychological benefits or risks of the drug. It is known that animals, especially monkeys and rodents, feel confused and alarmed when given psychotropic substances, whereas many humans find relief in these substances. Also, empathy and personal insight cannot be assessed in animals.

Based on this information, the Federal Court of Appeals overturned the DEA's scheduling, requiring them to provide legally viable reasons for their decision. In order to prove that a drug should be placed in the Schedule I category, the DEA would have to prove that it had a high potential for abuse, had no currently acceptable medical use, and was not safe for use under medical conditions. When asked why the drug should be placed in the Schedule I category, one DEA chemist stated: "MDMA has a high potential for abuse based on its chemical and pharmacological similarity to MDA, its self-administration without medical supervision, its clandestine synthesis, and its distribution in the illicit drug traffic," (Beck and Rosenbaum 1994). Interestingly, clinical studies have shown that MDMA does not appear to be physically addictive and many therapists believe that it has an accepted and safe medical use in psychotherapy. Ignoring the court's order, the DEA again placed MDMA in Schedule I on March 23, 1988 (Saunders 1996, Beck and Rosenbaum 1994). This action was never challenged and MDMA has remained in Schedule I ever since (Saunders 1996). It is likely the DEA hoped Ecstasy was a passing trend that would run its course with the public and then fade. But in fact, Ecstasy use has continually increased since the 1980s. Criminalization of Ecstasy seemed to have had little effect on users' attitudes towards the drug. Most MDMA users

could better be described as “believers” in the drug and remained loyal to it, though they were more cautious about how they purchased it and whom they included in the experience (Beck and Rosenbaum 1994).

In October 1992, the FDA approved the first human study of MDMA after facing the fact that the MDMA “trend” wasn’t passing and the drug needed to be better understood (Beck and Rosenbaum 1994). Federal funding was given to Dr. George Ricaurte, a researcher at Johns Hopkins University. Dr. Ricaurte researched the effects of MDMA on serotonin concentration, dopamine neurotoxicity, and cognition. He conducted numerous studies on the topic of Ecstasy throughout the 1990s and received an estimated ten million dollars in government funding during that time. His research was so critical to the government’s “War on Drugs” agenda that, on DEA web page of information about neurotoxicity and brain damage associated with Ecstasy use, the only four sources of data were all studies conducted by Dr. George Ricaurte and his wife Una McCann (DEA Website).

Although some of his studies may have been valid, his penchant toward exaggeration and sensational headlines drew attention from critics. For example, Ricaurte injected a small group of monkeys with MDMA and determined that there were changes in their brains consistent with dopamine neurotoxicity. Regardless of the quality of the research, the paper was hyped up to suggest that a single night using a recreational dose of MDMA could cause dopamine neurotoxicity resulting in Parkinson’s disease. The article even noted that there could be a Parkinson’s disease epidemic when current party and club goers get older (Ricaurte et al. 2001, 2002A, 2002B).

On September 5, 2003, Dr. George Ricaurte published a retraction in the journal *Science*. In the retraction, he stated that two bottles arrived at the lab on the same day, one containing 10 g of d-methamphetamine and one containing 10 g of racemic MDMA. He began to suspect that the bottles had been mislabeled after outside pressure to explain the surprising results mounted. The bottle labeled MDMA had already been discarded, but the bottle labeled d-methamphetamine was found to contain MDMA, when samples from the mislabeled bottle were analyzed by gas chromatography/mass spectroscopy (GC/MS) at three independent labs. Also, frozen brains of two of the animals used in the MDMA study were found to contain d-methamphetamine after GS/MS analysis at three independent labs. Not even trace amounts of MDMA or MDA, a metabolite of MDMA, were found in the monkeys. Ricaurte stated: “Subsequent to the publication of those findings, we were unable to extend the dopamine neurotoxicity to orally administered doses [of MDMA]. Multiple subsequent attempts to reproduce the original findings with systemically administered doses of MDMA identical to those used in the original study were also unsuccessful, under a variety of laboratory conditions,”. He continued by admitting that the results of the study, especially the high mortality rate and the pattern of dopamine and serotonin neurotoxicity, were consistent with d-methamphetamine use. This information was made available on the Multidisciplinary Association for Psychedelic Studies (MAPS) (MAPS Website). A key focus of Ricaurte’s original paper was a statement about how “dopaminergic neurons were damaged after MDMA equivalent to those taken recreationally by humans”. Alarming, the word “damaged” was replaced with “destroyed” in the press package of the article. When asked why the

word was changed Ricaurte simply replied that it was never meant to imply that cell bodies had actually degenerated. *Science* replied that the change was made “after consultation with the authors” and the word was only changed in one paragraph of the release (Walgate 2003).

RTI International, the company that supplied the chemicals used in the botched Ricaurte experiments, denies it is to blame for the error. Ricaurte stated that two identical bottles arrived at the lab on the same day; one bottle was labeled MDMA and one was labeled d-methamphetamine. He said that the labels were switched and, thus, the monkeys who died in the Ecstasy experiment were actually given d-methamphetamine. After reviewing the records of their transactions, the company said they found no evidence of a labeling error on their part. They also stated that they were disappointed that Dr. Ricaurte would place such certain blame on RTI (MAPS Website). The journal *Nature* published an editorial commenting on how peculiar it was that two of the ten research animals died and nearly all the rest had damage to neurons controlling mood and movement. The article stated: “The impression that low doses of Ecstasy, or MDMA, are extremely dangerous – misleadingly borne out by Ricaurte’s study, but not by two decades of observing the drug being used – will hamper legitimate research to determine whether MDMA could have useful psychotherapeutic properties,”. The article pointed out how Alan Leshner, chief executive of the American Association for the Advancement of Science (AAAS), which publishes the journal *Science*, publicly endorsed the study. It is not typical for an officer of the AAAS to publicly promote one particular result published in the journal, especially one whose methods and findings

were questioned by many experts from the outset. The author implies that Alan Leshner's previous position as director of the National Institute on Drug Abuse (NIDA), the organization that funded the research, may have had an effect on the amount and type of attention the study received. The article also noted that, although the initial paper received huge attention from the media, the retraction was released late on a Friday afternoon and little was done to spread word of the retraction (Nature 2003).

Colin Blakemore is a professor of physiology at Oxford University, chairman of the British Association for the Advancement of Science, and head of the U.K. Medical Research Council, which is the British equivalent of the NIH. In an interview with *Village Voice* author Carla Spartos, he stated that he sent a letter to Science immediately after reading the newly published Ricaurte papers and cited major flaws in the research. He later stated: "The press release deliberately misrepresented the data. There was no evidence of the 60 to 80 percent cell-death claim. The more I looked at it, the more I felt there was an agenda. [There were] flaws so radical, so deep, they would have been picked up by any referee,". He noted how the size of the dosage and route of administration of the drug were contrary to the "typical recreational dose" said to be used in the paper's introduction. This point was especially controversial because Ricaurte published a paper previously in which he stated that a subcutaneous injection of MDMA was twice as neurotoxic as oral administration in squirrel monkeys. In sharp contrast, he stated that oral administration offered little or no protection from neurotoxic effects in his next study. He also pointed out how 20% of the monkeys in the study died and another 20% got too sick to complete the study. This does not reflect the reality of human

recreational MDMA use, because millions of doses are used each year and 40% of users are not getting sick or dying. He asked the journal *Science* to release the referee reports, stating: “If the referees didn’t spot what I noticed right away, then what does that say about the quality of [*Science*’s] referees? And if the referees did make negative comments [that went unheeded], what does that say about *Science*?”. Lastly, he noted how Ricaurte’s study reported that MDMA use caused dopamine toxicity which might result in Parkinson’s disease but how three other studies found that although serotonin levels are depleted in heavy MDMA users, these users had normal dopamine levels. Two of the studies were done by in vivo brain imaging and one was done by post-mortem analysis.

In the same article, the author noted how Alan Leshner has a history of speaking against MDMA. Leshner once stated: “We’ve known since the late ‘80s that MDMA can damage serotonin neurons, and if you give enough of it, they’re blown away,”. The article describes how Leshner, during his time as director of NIDA, quadrupled the institute’s budget for Ecstasy research to \$15.8 million and how NIDA funds 85% of the world’s drug-abuse research. Critics also say that Leshner manipulated brain scans that actually showed no difference between MDMA users and controls and that he presented these scans to a Senate subcommittee on Ecstasy issues (Spartos 2004).

An article in the New York Times (2003) quoted Dr. Julie Holland, who is a professor of psychiatry at New York University and an expert on Ecstasy, as saying “It’s hard to trust George [Ricaurte],” she continues by saying that he is “playing games with his data” in order to get more grant money. In the same article, Dr. Richard Wurtman, a

prominent professor at Harvard and MIT who has clashed with Ricaurte, accused him of “running a cottage industry showing that everything under the sun is neurotoxic,”. More valuable than critiques are the facts that contradict Ricaurte’s work, which many, including Dr. Marc Laurelle, have found. Dr. Laurelle, a Columbia University PET scan expert, cited a yet-unpublished German study showing that serotonin levels decreased only modestly after exposure and returned to normal within six weeks. He also noted that in some of Ricaurte’s data, control animals had impossibly high initial serotonin levels – up to 50 times normal! Dr. Ricaurte responded to this by saying his “recalculation” technique was one typically used when results from two data groups vary widely, but also that he has discontinued using this technique (McNeil 2003).

On April 1, 2004, ABC aired a broadcast entitled “Ecstasy Rising”, hosted by Peter Jennings. It discussed the history of MDMA throughout the past three decades, focusing on the Ricaurte retraction and current turmoil. The article states that the federal campaign to curb MDMA use has not affected its popularity and reported that, at the current rate, 1.8 million Americans are expected to try the drug for the first time in 2004. The only drug that will attract more new users this year is marijuana. The article stated that overwhelmingly positive word of mouth was the most likely reason why Ecstasy still attracts so many new users. For example, one user stated: “After I used Ecstasy, I just felt like a whole new person, like it changed my life completely,”. Robert MacCoun, a drug policy analyst described the phenomenon: “There is an evangelical fervor with Ecstasy. People who experience it tell their friends to try it,”. Another analyst, Mark Kleiman, stated that he had never seen this happen before, “I have never heard anybody

say to me that methamphetamine improved my life. I know people who use cocaine, but I have never heard anybody claim that cocaine is good for me. But with MDMA, lots of people think that the drug has improved their life.”. Although Ecstasy use among teens has declined in the last two years, experts say this does not imply that the drug is on the way out, rather that the government’s efforts have had some effect but can’t compete with word of mouth (ABC Website)

Recently, the government approved a study to explore whether MDMA-assisted therapy could be used to treat patients with Post-Traumatic Stress Disorder (PTSD). If proven safe and effective, MDMA could legally be prescribed by therapists. The study was approved by the FDA in November 2001 pending approval by an independent review board (IRB). Many changes were made in order to perfect the procedure and it eventually received final IRB approval. The DEA also had to approve the project, but could only deny permission if there were reason to believe that the MDMA may be “diverted”, used for purposes outside the study. As long as the drug is kept in a secure place and every drop is accounted for, the DEA cannot refuse an FDA approved study. The DEA approved the study on February 24, 2004 and the project was given the green light (MAPS Website).

The study will involve an experimental group of twelve patients receiving MDMA and a control group of eight patients receiving a placebo. The study will be otherwise identical for both groups. Patients in the experimental group will receive a single 125 mg dose of 99.87% pure MDMA during a therapy session (Weiss 2004). Three to five weeks later, they will take another dose of MDMA during a second, final

experimental therapy session. Dr. Michael Mithofer, a Charleston, South Carolina psychiatrist, will oversee the research and conduct the therapy sessions (Weiss 2004). The MDMA will be synthesized by a chemist at Purdue University and will most likely be the purest ever produced. Participants must be literate and not diagnosed with borderline personality disorder. They must have at least one unsuccessful attempt at treatment with a selective serotonin reuptake inhibitor (SSRI), which lasted at least 3 months, and one unsuccessful attempt at treatment with a method of psychotherapy proven effective at treating PTSD patients, such as cognitive behavioral therapy. Psychotherapy must have lasted at least 6 months and included a minimum of 12 sessions. Participants will be given a consent form to read and then given a 16-question quiz to assess their comprehension of the study procedures. Participants who are also patients of Dr. Mithofer must be interviewed by an independent psychiatrist and an equal number of the researcher's patients will be placed in each groups (MAPS Website). Since there is a rare but potential risk of complications such as heat stroke, an emergency room doctor and nurse will be stationed outside the therapy room (Weiss 2004). The researchers will remain with the subject until they conclude that he or she is emotionally stable. If the participant is extremely agitated or upset he or she will be hospitalized until stable. All patients will be required to stay overnight and will be driven home the next day, regardless of whether they are deemed stable after the session. A registered nurse of the same gender as the subject will be present for the overnight stay. The researchers will maintain daily contact with the subject for the first week after the session. The final follow up will occur three months after the first session and, at that time, participants will

fill out a 24-item survey evaluating their reasons for participating in the study, the overall experience of participating, and the perceived costs and benefits of participation. The survey will contain questions addressing whether participation was due to perceived coercion or influence by researchers. The study was carefully constructed and every precaution was taken to ensure the safety of participants while collecting valid, unbiased data. (MAPS Website).

Chemistry

Ecstasy is the street name for the racemic chemical (\pm)-N, α -Dimethyl-1,3-benzodioxole-5-ethanamine hydrochloride, also known as N-Methyl-3,4-Methylenedioxyamphetamine (Sigma Website). The chemical name is pronounced “Three-Four Methylene Dioxy N Methyl Amphetamine”. It is more commonly called methylenedioxyamphetamine or by the abbreviated name MDMA (Saunders 1996). Street-names for MDMA include “X” in the U.S. and “E” in Britain. It is also sometimes referred to as “Adam”, though this term was more common in the 1970s and early 1980s (Saunders 1996).

The chemical formula of MDMA is $C_{11}H_{15}NO_2$ and the molecular weight is 193.25 (Saunders 1996). It is a white crystalline solid that is normally hydrated and melts at 148-153°C, depending on the method of synthesis (Saunders 1996, Erowid Website). MDMA is chemically stable and has a very long shelf life, as it does not decompose in light, air, or heat (Saunders 1996). It is a ring-substituted derivative of phenethylamine that has analgesic and central nervous system stimulating effects.

Pharmacologically, it is considered to be an indirect monoamine agonist (DEA Website).

The secondary amine structure of MDMA is unique because all other known hallucinogenic and amphetamine agents are most potent as primary amines. Figure 1 shows the line structure of MDMA.

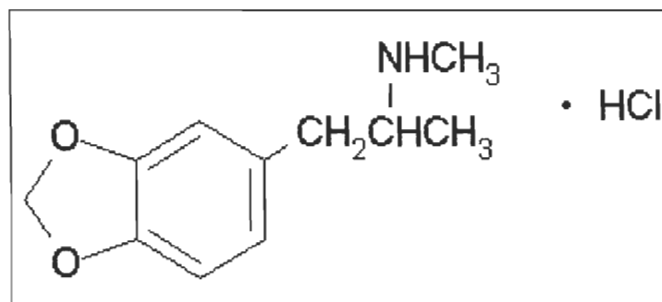


Figure 1. Chemical structure of MDMA (Sigma Website).

For MDA, a chemical similar to MDMA, both the R(-) and S(+) optical isomers are active but the R is slightly more potent and each produces different effects.

Interestingly, the S(+)-dextrorotatory optical isomer of MDMA is active but the R(-)-levorotatory isomer is inactive even at high doses (Cohen 1998). Figure 2 shows the chemical structure of the more active “S” or (+) enantiomer. In the figure, red represents oxygen, blue is nitrogen, black is carbon, and white represents hydrogen.

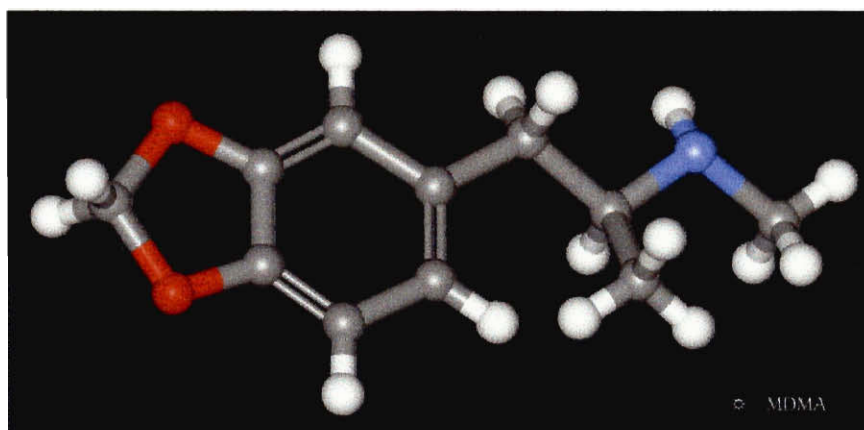


Figure 2. Chemical structure of MDMA in 3-D (Erowid Website).

MDMA is rated as a level three health risk and level zero flammability and reactivity risks by both the NFPA and HMIS (Sigma Website). The dose required to kill 50% of a sample population (LD_{50}), for mice is 97 mg/kg, for rats is 49 mg/kg, and for guinea pigs is 98 mg/kg with all doses being delivered intraperitoneally (Erowid Website). The LD_{50} is 40 mg/kg for an oral dosage fed to rats. For intravenous administration in dogs and monkeys, the lethal dose was 97 mg/kg and 22 mg/kg, respectively (Sigma Website).

MDA (3,4-Methylenedioxyamphetamine) and MDEA (3,4-Methylenedioxyethylamphetamine, also called MDE or Eve) are the two closest chemical analogues to MDMA. Figure 3 shows the structure of MDA and Figure 4 shows the structure of MDEA. Although chemically similar, there are distinct differences among the substances. For example, the duration of a typical MDA “high” is 8-12 hours, for MDMA it is 4-6 hours, and for MDEA it is 3-5 hours. Also, MDA causes amphetamine-like effects, including dopamine release, unlike MDEA or MDMA. MDEA produces

effects that are similar to MDMA. All three can cause frequent users to become “tolerant”, resistant to drug’s effects with repeated use, but MDEA, MDMA, and MDA do not cause cross-tolerance with one another. This means that, while a person may have used MDA so often that they are resistant to its effects, their resistance to MDA does not confer resistance to MDMA. The MDA-resistant user will feel the effects of MDMA that a non-MDA-resistant user would (Saunders 1996).

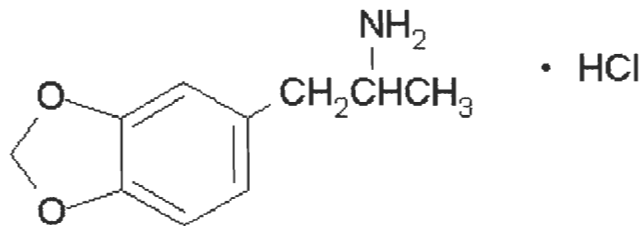


Figure 3. Chemical structure of MDA (Sigma Website).

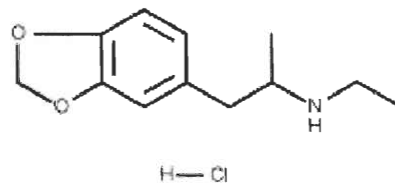


Figure 4. Chemical structure of MDEA (Sigma Website).

Since the drug is illegal in many countries, almost all MDMA seized has been produced in clandestine labs or in foreign manufacturing plants. Most of the MDMA present in Europe, England, and the U.S. has been smuggled in from Belgium, the Netherlands, and Israel, but a few clandestine labs have been found in the U.S. The drug

typically arrives in the U.S. through express mail shipments, courier services, or airfreight shipments and shipments typically contain 10,000 pills or more. Israeli syndicates are the primary source of distribution in America. Seizures of MDMA have increased dramatically in recent years, from 196 tablets seized in 1993 to 143,600 in 1998. In the first 5 months of 1999, the DEA seized over 216,000 tablets of Ecstasy (DEA Website).

Ecstasy is usually sold on the street in tablet or pill form, but capsules and powder have also been found. In the U.S., Ecstasy tablets are sold at the mid-wholesale level for eight dollars per tablet and at the retail level for around twenty-five dollars per tablet (DEA Website). Pills are often stamped with a “brand” so consumers can distinguish the product of one producer from that of competitors. The brand is a tiny picture or word stamped onto the face of the pill and common brands include butterflies, clovers, and lightning bolts. Figure 5 shows three “McDonalds” brand pills sold as Ecstasy, although their actual contents were not analyzed. The brand stamp is visible on the front of the pill and there is a groove on the back so that the pill can be split in half. (Erowid Website).



Figure 5. Pills sold as Ecstasy with the “McDonalds” brand on front (Erowid Website).

Making a drug illegal often reduces the quality and predictability of doses purchased on the street. With Ecstasy, it is believed that consumers have a 10% chance of purchasing a pill that is completely psychotropically inactive, such as an aspirin or a sugar pill, and a 66% chance of purchasing a variable dose of actual MDMA. In pills purchased on the street, MDMA is often “cut” or mixed with other drugs, typically amphetamine, ephedrine, MDA, MDE or DXM. DXM is the active and sometimes abused medication in “-tussin” type cough medicines (Erowid Website). There is also a 24% chance that the pill will not contain MDMA but will contain MDMA-like substances, a “cocktail” of drugs to simulate Ecstasy’s effects, or straight amphetamine. Pills containing MDMA-like substances contain MDA or MDEA and pills containing a cocktail of drugs typically contain a mix of LSD and amphetamine (Holland 2001). Another danger to the uneducated Ecstasy buyer is a drug commonly sold as “liquid Ecstasy” at clubs and parties. The drug is actually Gamma-Hydroxybutyrate (GHB), a very dangerous drug with no relationship to MDMA. GHB is often known as a “date rape drug” with effects similar to those of alcohol intoxication (Reynolds 1999).

Usage

The street term for the state of being on Ecstasy is “rolling” and the experience itself is called a “roll”, for example “Are you rolling?” would be asking someone if they are on Ecstasy and “How was your roll?” would be asking someone about how the experience was. The term may have come from users’ tendencies toward repetitious

actions like as rocking back and forth, or from the drug's roller coaster like experience, beginning with a sharp peak and then a smooth "ride" (Erowid Website).

A survey conducted in 1991 found that in the U.S. only 0.2% of individuals had used Ecstasy in the previous 30 days and only 0.9% in the past year (Saunders 1996). In England, a countrywide survey of school age children found that 4.25% of 14-year-olds had tried it (Saunders 1996). As part of this project, a survey of MDMA use at WPI was conducted. An anonymous survey was placed in each student mailbox, approximately 3,120, and the author's return address was printed on the back of each survey to protect confidentiality. Students were asked simply to report their class year, gender, and answer 'yes' or 'no' to the question "Have you ever tried Ecstasy (MDMA)?". About 27% of the slips were completed and returned. Of the 829 people who returned the survey completed, 602 (72.6%) were male and 227 (27.4%) were female. Of the respondents, 7.7% (n = 64) admitted to trying Ecstasy, broken down by gender 7.5% (n = 45) of male and 8.4% (n = 19) female respondents. Table 2 shows the results, broken down by class year, gender, and response.

Table 2. Survey of Ecstasy Use in the WPI Student Population.

Total Participants	Class Year (n*, %**)	Gender (n*, %**)	Response (n*, %**)
829	2004 (201, 24.2)	Male (141, 17.0)	Yes (14, 1.7)
			No (127, 15.3)
		Female (60, 7.3)	Yes (7, 0.8)
			No (53, 6.4)
	2005 (170, 20.5)	Male (134, 16.2)	Yes (17, 2.1)
			No (117, 14.1)
		Female (36, 4.3)	Yes (6, 0.7)
			No (30, 3.6)
	2006 (231, 27.9)	Male (171, 20.6)	Yes (7, 0.8)
			No (164, 19.8)
		Female (60, 7.3)	Yes (3, 0.4)
			No (57, 6.9)
2007 (227, 27.4)	Male (156, 18.8)	Yes (7, 0.8)	
		No (149, 18.0)	
	Female (71, 8.5)	Yes (3, 0.4)	
		No (68, 8.2)	

* The variable “n” represents the number of participants in this category.

** The “%” represents the percent of total respondents (= 829) selecting that response.

Researchers consider the demographics of MDMA usage to be surprising when compared with other recreational drugs. As with many other drugs, college students and homosexual men have been identified as major MDMA using populations. Surprisingly, a considerable number of middle and upper class professionals also use the drug (Beck and Rosenbaum 1994).

Sometimes users try non-oral routes of administration in an attempt to enhance the experience. In one study, 33% of users had tried snorting Ecstasy, but most tried this only once because it caused too many “speed-like” effects. Also, snorting MDMA caused a burning sensation, produced a foul tasting “drip” down the throat, and/or decreased the duration of the plateau (Beck and Rosenbaum 1994).

A common problem with Ecstasy, as with many other drugs, is that some users want to increase the effects by taking more than the normal 100 to 150 mg dose. The risky behavior of taking multiple pills at once is known as “stacking”. Although most stacking is intentional, some users simply do not wait a sufficient amount of time for the pill to take effect. Because of the unreliability of street pills sold as Ecstasy, they assume it was a fake pill containing no MDMA, and consume another. If both were actually potent, they will soon be feeling the effects of two pills (Reynolds 1999). Also, unpredictable doses and ingredients can cause users to expect weakly potent pills and they may over-compensate by taking multiple doses at once to enhance the effects. The consumer who unknowingly purchases highly potent pills may expect them to be less potent and inadvertently overdose (Holland 2001).

Users often report that large doses increase the psychological “speed-like” and/or hallucinatory effects of the drug but do not enhance the euphoric feelings. Consuming large amounts of Ecstasy often lead the user to feel lethargic, referred to as being “cabbaged” or “puddled”. While a typical dose makes the user feel happy, talkative, and active, too much makes the user feel sluggish. Users often report that after taking too much MDMA, their bodies may not be active, but their minds are racing. They are so consumed in their own racing thoughts that they are not aware of the world around them. This situation may be disappointing compared to expected effects, such as chatting and dancing, but most report that it is not necessarily a negative experience. At high doses, MDMA causes a decrease in movement and coordination and an increase in involuntary eye twitching (Beck and Rosenbaum 1994). Characteristics of an MDMA overdose

include high blood pressure, feeling faint or fainting, panic attacks, seizures, and very high body temperature (DEA Website).

Many novice users experiment with taking “booster” doses after an initial dose in order to prolong the experience. Like cocaine users, binge-oriented or inexperienced MDMA users may find it difficult to avoid exhausting their entire supply after taking one dose. Even if limits are set before ingesting the first dose, once the drug has taken effect, the user may attempt to procrastinate coming down by taking more doses until they have depleted their entire supply (Beck and Rosenbaum 1994). Often they find that, although they may enjoy the plateau for a longer period of time, the number of adverse side- and aftereffects is greatly increased. In particular, the instance of jaw tension, fatigue, and psychological disturbances increases (Beck and Rosenbaum 1994). Taking booster doses can also cause the user to develop a tolerance more quickly to the drug’s effects. Veteran users are less likely to overuse Ecstasy and are more likely to carefully plan their next experience in order to maximize positive effects and minimize negative ones (Beck and Rosenbaum 1994).

Often, over-users will attempt to re-attain the euphoric feelings by mixing MDMA with other drugs (Holland 2001). Some users, especially those taking MDMA at party or club, will “candyflip” or “hippieflip”. Candyflip means that a user is taking Ecstasy with LSD and hippieflip means that he or she is taking Ecstasy with psilocybin “magic” mushrooms. This is done to enhance the hallucinogenic and sensory effects of the experience (Saunders 1996). A study stated that nearly 80% of British Ecstasy users who took the drug in a party or club setting took amphetamine to enhance the experience.

Ecstasy is also frequently taken with cannabis, “poppers”, and Temazepam (Reynolds 1999). In the study conducted by Verheyden et al. (2003), 430 MDMA users were surveyed. Of them, 80.1% had combined MDMA with tobacco, 55.0% had combined it with amphetamine, 53.1% had combined it with marijuana, and .7% had never combined MDMA with another drug. Overall, 59% of users in the study admitted to always combining MDMA with another drug (Verheyden et al. 2003).

A number of different studies have concluded that the chronic MDMA user, described as a person who has taken large doses, frequently, over long periods of time, has yet to be found. The drug is often described as “self-regulating” in that overuse results in decreased euphoria and increased adverse effects, thus deterring addiction (Beck and Rosenbaum 1994). Since serotonin levels take longer to replenish than dopamine levels, people who use Ecstasy daily are often left without the desirable euphoric buzz. One study concluded that two main factors influence declines in MDMA usage. The first factor is that many users believe the first time was the best and that subsequent uses were not as intense, the second is that they have noticed an increase in the number and duration of aftereffects (Beck and Rosenbaum 1994). A survey of 430 MDMA users in the London showed that participants took the drug an average 2.79 days/month at the start of use, decreasing to 1.85 days/month at the time of the interview. At the same time, the amount of MDMA consumed in a typical session increased from 1.2 tablets to 1.8 tablets (Verheyden et al 2003). Table III shows the results of survey questions regarding situations that might prompt an MDMA user to stop using.

Table III. Situations Prompting an MDMA User to Stop Using (Verheyden et al. 2003).

Potential Reasons for Quitting	% of Sample Giving Reason (n = 417)
Fear of Long-Term Effects on Mental Health	66.9
Fear of Long-Term Effects on Physical Health	46.0
Quality of MDMA was Falling	34.3
Knew Someone who Died as a Result of Taking MDMA	30.7
Spending Less Times at Clubs	29.7
Personally Having a Bad Experience on MDMA	22.1
Friends Were Quitting	25.4
Knowing Someone Who Became Mentally Ill	18.7
Thinking It Was Affecting Work/Studying	17.7
Fear of Short-Term Effects on Mental Health	16.5
Seeing Someone Else Have a Bad Experience on MDMA	16.5
Thinking It Might Effect Job	15.8
Knowing Someone Who Became Physically Ill	13.7
Fear of Short-Term Effects on Physical Health	12.7
Spending Less Time in Pubs	12.0
Getting a Criminal Record	10.1
Spending Less Time at Parties	7.4
Pressure From Relatives	2.4
Relatives Finding Out About MDMA Use	2.2

Since MDMA does not cause physical withdrawal symptoms, it is not considered to be physically addictive. It can, however, lead to the use of physically addictive drugs, such as amphetamine and cocaine (Saunders 1996). Some experts speculate that MDMA may be emotionally addictive, since normal life could seem empty or dull in comparison to the experience of being on Ecstasy (Holland 2001).

The Experience

A typical dosage of MDMA is 100 to 150 mg ingested orally and takes approximately 20 to 60 minutes to take affect on an empty stomach (Beck and Rosenbaum 1994). The Ecstasy experience is often described in three distinct phases:

“coming up”, the plateau, and comedown (Holland 2001). When the drug begins to take effect, most users describe the suddenness and intensity of the experience as a “wave” or “rush”. Users typically enjoy this, although some people feel transient nausea and/or anxiety during this time, especially new users (Beck and Rosenbaum 1994).

The plateau phase is generally the most enjoyed, with users reporting a “leveling off” of effects and greater sense of relaxation. This typically lasts 2 to 3 hours and users engage in a wide range of activities including dancing, talking, introspection, and sensual contact. Ecstasy reduces inhibitions, cynicism, and fear and enhances openness, understanding, and communication (Erowid Website). Many users enjoy the controllability of the MDMA high. As one user put it: “You can be feeling completely euphoric and then your mom calls and you can talk to her completely clear-headed, without her even knowing”. This contrasts the effects of drugs like LSD (Beck and Rosenbaum 1994). A study conducted in Sydney found that 80% of those who tried Ecstasy enjoyed it, 13% found the experience neutral and 7% did not enjoy the experience (Saunders 1996).

As with any drug, legal or illegal, users can experience adverse effects. The most apparent of these is dilation of the pupils (mydriasis), lasting throughout the plateau and easing during the comedown. Even in bright light, the pupils remain open, so people often prefer dim lighting while using MDMA (Sigma Website). Other common physical side effects include dry mouth, trisma (jaw tension), bruxism (teeth grinding), nystagmus (involuntary eye flickering), loquacity (excessive talking), and hyperthermia (elevated body temperature). Some users chew gum or suck on pacifiers to relieve jaw clenching.

Uncommon side effects that some users experience are nausea and panic attacks leading to hyperventilation, especially when the drug first takes effect. This appears to be transitory, resolving when the effects plateau. The DEA categorizes MDMA as a hallucinogen although it produces only mild visual hallucinations, which occur only in very rare instances. While most users enjoy the “clarity” of the MDMA experience and would consider hallucinations to be an adverse side effect, some may find them pleasurable (Erowid Website). One of the most interesting side-effects of MDMA, a drug which makes users want to kiss, touch, and hold one another, is that it impairs erection in male users and inhibits ejaculation almost entirely. Female users also find it difficult, but not impossible, to become aroused and achieve orgasm when using MDMA (Reynolds 1999). Some users feel conflicted because they have a strong desire for sexual contact but are unable to maintain arousal or achieve orgasm (Beck and Rosenbaum 1994). Table IV shows the results of a study that evaluated the incidence of certain effects during MDMA use.

Table IV. Effects of Ecstasy During Usage (Saunders 1996).

Effect	% Experiencing that Effect
Altered time perception (sped up or slowed down)	90%
Increased ability to interact with or be open with others	85%
Decreased defensiveness	80%
Decreased fear	65%
Decreased sense of alienation or separation from others	60%
Changes in visual perception	55%
Increased awareness of emotions	50%
Decreased aggression	50%
Speech changes	45%
Awareness of previously unconscious memories	40%
Decreased obsessiveness	40%
Cognitive changes	40%

The comedown phase usually begins 3 to 4 hours after initial ingestion and is long and gradual. The comedown experience is very varied; some users feel a “mellow glow” and fall asleep easily, others feel jittery and cannot sleep. While most users experience fatigue and may be irritable during this time, rarely, some users experience mood swings similar to those of manic-depression (Holland 2001). Users respond to the comedown in a variety of ways, some take a smaller dose of Ecstasy to extend the plateau, some use other drugs including marijuana, alcohol, or tranquilizers, and some engage in a relaxing activity like taking a bath (Beck and Rosenbaum 1994).

Almost all users experience some aftereffects for a day or two following Ecstasy use and this is often thought of as the most problematic part of the experience (Beck and Rosenbaum 1994). Rarely, some people report feeling an “afterglow” following comedown, but Ecstasy use is almost always followed by a hangover (Holland 2001). Besides the hangover, many MDMA users experience increased post-usage susceptibility

to illnesses, such as sore throats, colds, herpes outbreaks, and urinary tract infections. It is believed that this has more to do with setting - crowded, hot, and poorly ventilated clubs - and behavior – dancing for prolonged time, decreased desire to drink and eat, and lack of sleep – than with the drug itself. One physician noted that latent infections could be activated by the physical stress, especially in the female genito-urinary area (Beck and Rosenbaum 1994).

While dopamine is rapidly replaced in the brain, it takes about 1 week after moderate use for serotonin levels to normalize. With excessive use, it can take up to six weeks to replenish serotonin. Long-term psychological effects of MDMA use include depression, paranoia, anxiety disorders, and panic attacks (Holland 2001). Table V shows the effects reported by users at 24 and 48 hours after MDMA use. It is described in terms of the percent of 428 study participants who reported experiencing that effect. Table VI shows the instance of effects that lasted up to 1 week after MDMA use. Table VII shows the instance of effects that lasted more than 1 week after MDMA use.

Table V. Instance of Effects 24 and 48 Hours after MDMA Use (Verheyden et al. 2003).

Symptom/Effect	% Reporting at 24 hr. after Use	% Reporting at 48 hr. after Use
Euphoric Rush	91.6	4.1
Felt Thirsty	74.3	11.9
Felt Warm Towards Others	64.0	14.3
Felt Heartbeat Increase	57.0	4.6
Felt Good About Self/Confident	49.1	9.0
Chewed Mouth/Shook Jaw	40.0	28.6
Felt More Aware/Heightened Perceptions	26.9	7.3
Felt Calm/Serene	20.3	25.7
Felt Omnipotent	19.6	4.6
Became Confused/Disoriented	18.9	7.5
Lost Appetite	17.1	34.6
Hard to Get Out of Bed the Next Day	15.7	40.2
Had Trouble Sleeping	9.1	34.1
Experienced Hallucinations	7.5	3.6
Became Over-Excited	7.2	5.3
Felt Anxious/Panicky	6.3	11.1
Felt Sick/Vomited	6.3	4.1
Felt Paranoid/Persecuted	4.0	9.2
Had a Headache	2.6	9.0
Skin Became Irritated/Got Mouth Ulcers	2.3	8.2
Became Delirious	2.1	1.2

Table VI. Aftereffects of Ecstasy Use Lasting up to 1 Week After Use (Saunders 1996).

Effect	% Experiencing Effect
Decreased sleep	40%
Decreased appetite	30%
Increased sensitivity to emotions	25%
Decreased ability to perform mental or physical tasks	20%
Decreased desire to perform mental or physical tasks	20%
Increased ability to interact with or be open with others	20%
Decreased defensiveness	20%

Table VII. Aftereffects of Ecstasy Use Lasting More Than 1 Week (Saunders 1996).

Effect	% Experiencing Effect
Improved social/interpersonal functioning	50%
Changes in religious/spiritual orientation or practice	46%
Changes in values or life priorities	45%
Improved occupational functioning	40%
Increased ability to interact with or be open with others	35%
Decreased defensiveness	30%
Changes in ego boundaries	30%
Decreased desire to use alcohol	25%
Decreased fear	20%

Morbidity and Mortality

While the neurotoxic potential of MDMA is a highly disputed topic in the science community, how the body processes and expels MDMA is understood. After ingestion, MDMA is digested in the stomach and released into the blood. Some of the MDMA is metabolized by the liver into MDA, which is also an active substance. MDA, unprocessed MDMA, and other impurities are then sent to the kidneys for release in the urine. The total amount of urine expelled by an MDMA user will contain approximately 66% of the dose of MDMA unaltered, plus 7% of the dose released as MDA. This indicates that the urine of a person using MDMA contains “active” or potent chemicals. The biological half-life of MDMA in a human is 6 hours (Saunders 1996). Meaning that 6 hours after ingestion, 50% of the MDMA dose is expelled. Twelve hours after ingestion another 25% of the dose is expelled, 18 hours after ingestion another 12.5% is expelled, and so on. Thus, 18 hours after ingestion, approximately 87.5% of the drug has

been expelled from the user's body through urination. MDMA can usually be detected in urine for 2-5 days after use (Saunders 1996).

The instance of allergic reaction to MDMA is extremely rare (Holland 2001). Most deaths associated with using Ecstasy have been caused by overexertion, bingeing, and/or mixing MDMA with other drugs. A study of 'Ecstasy' and poly-drug related deaths in England and Wales from 1996-2002, reported that there were 202 deaths, with the number increasing each year of the study. In this study, 'Ecstasy' included MDA, MDMA, MDEA, and PMA. Of the deaths, 75% were users under the age of 29 and 80% were male. In 17% of cases, Ecstasy was the only drug consumed; the rest had consumed Ecstasy with other drugs, mainly alcohol, cocaine, amphetamines, or opiates. Toxicology results showed that MDMA was present in 86% of cases, MDA was present in 13% of cases, and PMA and MDEA accounted for only one case each (Schifano et al. 2003).

With all this considered, the mortality rate for Ecstasy use is extremely low compared to other risky behaviors. In the UK, for instance, there are approximately 100,000 deaths attributed to tobacco-related illness and 35,000 deaths from alcohol-related illness and accidents annually. Ecstasy has been implicated in 70 deaths over a ten-year period, approximately 7 deaths per year. Considering that an estimated 500,000 doses are consumed each weekend in Britain, the risk seems comparatively small. This number is also significantly less than that of other illegal drugs, such as heroin (150 deaths per year) and amphetamines (25 deaths per year) (Holland 2001). DAWN, a part of the U. S. National Institute of Drug Abuse known as the 'Drug Abuse Warning Network', collects reports of illegal drug use from emergency rooms. Each year DAWN

publishes a list of drugs that have caused more than 10 deaths and Ecstasy has never been included on that list (Saunders 1996).

The combination of MDMA's stimulant properties and the rave scene's dance-all-night atmosphere can produce a dangerous situation (Holland 2001). While on Ecstasy, the user's body temperature is sometimes elevated. Dr. Christopher Gordon, a specialist in temperature control mechanisms, stated that MDMA was one of the most effective chemicals he had observed for causing animals to lose control of their body temperature. In an experiment, rats were placed in a hot space and given MDMA. Instead of attempting to cool down and reduce their activity, the rats showed increased metabolism and activity, resulting in heat stroke (Saunders 1996). The risk of overheating is compounded by an increased level of activity and the fact that Ecstasy is often used in crowded and poorly ventilated venues, such as warehouses and nightclubs.

Hyperthermia is the most common morbidity associated with Ecstasy use. In emergency rooms, health professionals have reported seeing patients with temperatures as high as 108°F. A critically high temperature can cause blood in the circulatory system to clot. If a clot lodges in the lungs, a pulmonary embolism could occur, and if a clot lodges in the brain, it could lead to a stroke. Also, healthy people often develop small tears in tissue throughout their body and clotting agents are readily available to patch them quickly and without problem. During hyperthermia, clots are forming randomly in the blood, so clotting agents are being used up, the small tears are not being patched, and internal bleeding can occur.

Drinking plenty of water or isotonic beverages, like Gatorade, and taking breaks to rest and cool off can help minimize the risk of overheating (Holland 2001). Drinking enough water is a dual-edged sword, however, because drinking too much water can also be dangerous. Unfortunately, one of the most famous deaths associated with MDMA use had to do with just that. In Britain in 1995, Leah Betts ingested Ecstasy for the first time at her eighteenth birthday party. Friends told her to avoid overheating and dehydration by drinking plenty of water. Leah collapsed later that night and was rushed to the hospital, where she died. Doctors determined that she had died from hyponatremia (dangerously low levels of salt in the blood) caused by drinking an excessive amount of water in a short period of time (Holland 2001).

Current Research

Not all current research on MDMA has the flaws that the Ricaurte studies had. There are many valid studies that should be made public. In 1993, Dr. James O'Callaghan was attempting to use rats to establish a method of assessing general neurotoxicity. He determined that increases in glial fibrillary acidic protein (GFAP) were associated with neurotoxicity that resulted in impaired function. Experimenting with a broad spectrum of causes of neurotoxicity including age deterioration, stab wounds, air pollution, and disease, he consistently observed GFAP increase and neurotoxicity after exposure. He also experimented with MDMA and found that administering a single dose of 20 mg/kg to rats did not affect GFAP levels but did cause a long-term decrease in serotonin. Increases in GFAP levels were not observed until the rats were given doses of

75 to 150 mg twice a day for two days. Although serotonin depletion was observed after administering low and moderate doses of MDMA, he concluded that this did not necessarily indicate neurotoxicity (Saunders 1996). A subsequent study showed an increase in GFAP after exposure to MDMA (or other aromatic monoamine releasers) only when hyperthermia was also present. In the study, research animals whose temperatures exceeded 40.6°C and who were exposed to MDMA showed an increase in GFAP. Animals who were exposed to MDMA but did not experience hyperthermia did not have increased levels of GFAP. Conversely, animals with physically or chemically induced hyperthermia, but who were not exposed to MDMA did not have elevated GFAP levels (Schmued 2003).

In a study conducted at Glasgow University, MDMA was shown to affect the response of the circadian clock to light-related on non-light-related stimuli in rats. Previous studies have shown that the effect of MDMA on SCN (suprachiasmatic nuclei) neurons can be observed even 20 weeks after use. The study showed that MDMA's ability to affect SCN neurons was not caused by dopamine release, because dopamine inhibitors were used effectively. Researchers found that when dopamine inhibitors were used acute hyperthermia did not occur. The two major results of this study were that hyperthermia and dopamine release did not cause SCN changes after MDMA use and that dopamine inhibition can prevent hyperthermia during MDMA use (Dafters 2003).

Another study examined the relationship between MDMA usage and episodes of Malignant Hyperthermia (MH) in MH-susceptible swine. MH is an autosomally inherited condition caused by a point mutation, which results in abnormal calcium ion

metabolism in skeletal muscle fibers characterized by hypermetabolism. MH can be triggered by potent anesthetics and depolarizing muscle relaxants and symptoms include muscle stiffness, shivering, acidosis (acidic blood pH), tachycardia (racing heart), hypoxemia (low blood oxygen), hypercarboxemia (high level of carbon dioxide in blood), and elevated body temperature. Dosages of 4, 8, and 12 mg/kg were used in pigs, the equivalent of 4 to 8 street tablets of Ecstasy. The 4 mg/kg dose caused only slight changes occurred in MH-susceptible and control (non-MH-susceptible) swine, but the 8 mg/kg dose induced MH in all susceptible swine. The results of this study may explain why some users experience a violent hyperthermic reaction to a recreational dose of MDMA while the majority of users do not experience hyperthermia (Fiege 2003).

Studies have also been done to research the effects of MDMA use during pregnancy. One study of rats given MDMA on different gestational days found no difference in birth weight, litter size, duration of gestation, or physical appearance of offspring compared with control animals. Subtle behavioral changes, such as increased olfactory sensitivity, were noted (Saunders 1996). Another study found a slight reduction in birth weights of rats that had been exposed to MDMA prenatally compared to unexposed control rats. They also found that the experimental rats exhibited some developmental delays. The results were further analyzed by comparing rats that had low birth weights not related to MDMA (Caused by a large litter, where nutrients to each individual are reduced.) to those with a low birth weight after MDMA exposure. The research showed that MDMA-exposed rats had difficulty navigating through mazes, signifying impaired spatial and sequential learning. The experimental rats did not differ

from control rats in cued learning tests (Williams et al. 2003). In closure, it is important to note that consumption of legal or illegal drugs during pregnancy without medical supervision is always unadvisable.

One of the most common myths about MDMA is that it depletes spinal fluid or “fuses” the spinal chord. This myth is prevalent on college campuses and is believed to have originated from research experiments using monkeys. Researchers evaluated the damage to serotonin producing neurons in the brains of monkeys exposed to MDMA by measuring the amount of serotonin present in the spinal column, which required draining fluid from the chord. They found a direct correlation between the amount of serotonin present in the spinal column and the functionality of serotonin secreting neurons in the brain, but whether serotonin depletion can be linked to other changes or impaired function is still highly disputed (Beck and Rosenbaum 1994). In a similar study, rats were given a low dose regimen consisting of 1 dose of 5 mg/kg or a high dose regimen consisting of 4 doses of 5 mg/kg over 4 hours and tested for social anxiety 10 weeks after exposure. The research showed that rats receiving MDMA were significantly more anxious than controls. Three months after exposure, the rats were killed and their brains examined. Rats given the high-, but not the low-, dose showed significant depletion of serotonin, especially in the hippocampus, amygdala, striatum, and cortex. The doses did not affect the density of the 5-HT_{1A} type of serotonin receptor, but the 5-HT_{1B} type of serotonin receptor showed variable results. While the number of this type of receptor actually increased in some locations after the high-dose regimen, in other areas binding ability decreased. Density of the third type of serotonin receptor, 5-HT_{2A/2C}, decreased

dramatically after both regimens, but only in certain locations in the brain (McGregor et al. 2003). Advocates of the drug responded by noting that other studies too show a decrease in serotonin after use but that serotonin levels returned to normal over time. They also noted that serotonin depletion does not necessarily imply neurotoxicity or that brain damage has occurred (Saunders 1996).

Harm Reduction Strategy

Harm reduction strategy is based on the theory that harm results from the way in which drugs are used and that these ways can be influenced. Dr. Russell Newcombe has, in the book Ecstasy: Dance, Trance & Transformation, suggested that there are four main components of harm reduction strategy:

1. Acknowledge that people are not likely to stop seeking “highs”. It is important to take a caring, nonjudgmental approach in order to educate drug users, not alienate them.
2. Base the strategy on knowledge. Focus on controlling use rather than on abstaining from use and provide information on appropriate doses, effects, routes of administration, when to seek help, and common hazards.
3. Focus on maximizing the probability of success. Target high-risk populations and make the information easily accessible and understandable.
4. Follow up, if possible, to evaluate the effectiveness of the strategy.

Dancesafe is an organization dedicated to educating people about the dangers of

drugs, including Ecstasy, and providing risk prevention strategies. They offer confidential and nearly free pill testing to determine whether pills contain MDMA or other substances. Adulterant testing kits are available for purchase on the site. On its site, Dancesafe lists contraindications for MDMA use such as a history of MH, seizures, heart disease, or liver disease. It also urges people on monoamine oxidase inhibitors (MAOIs) or drugs metabolized by the liver enzyme CYP2D6, which also metabolizes MDMA, not to use Ecstasy. DXM, an ingredient in cold medicine and sometimes “cut “ in Ecstasy tablets, and the protease inhibitor Ritonivir are metabolized by CYP2D6 (Dancesafe). The Dancesafe website was used as a guide when producing the pamphlet.

The harm reduction strategy inspired this project. The purpose of the educational pamphlet is to offer a simple format with pertinent, understandable facts about Ecstasy. The pamphlet provides non-judgemental information about Ecstasy’s history, chemistry, experience, risks, and current research. The pamphlet was modeled after typical information pamphlets available in most health service locations. The paper is an in-depth version of information presented in the pamphlet and was used as a guide in creating it. The purpose of the survey was to evaluate the need for such a pamphlet. This project was created to dispel myths and gather information about Ecstasy and release this information, in a useable format, to current and potential users of the drug, because an educated consumer is a safer consumer.

Appendix 1. MDMA Material Safety Data Sheet from Radian.

RADIAN -- DL-3,4-METHYLENEDIOXYMETHAMPHETAMINE (DL-MDMA) IN
 MATERIAL SAFETY DATA SHEET
 NSN: 685000F050938
 Manufacturer's CAGE: 29913
 Part No. Indicator: A
 Part Number/Trade Name: DL-3,4-METHYLENEDIOXYMETHAMPHETAMINE (DL-MDMA)
 IN
 METHANOL

 =====
 General Information
 =====

Company's Name: RADIAN CORPORATION
 Company's Street: 8501 NORTH MOPAC BLVD
 Company's P. O. Box: 201088
 Company's City: AUSTIN
 Company's State: TX
 Company's Country: US
 Company's Zip Code: 78720-1088
 Company's Emerg Ph #: 512-454-4797
 Company's Info Ph #: 512-454-4797
 Record No. For Safety Entry: 001
 Tot Safety Entries This Stk#: 001
 Status: SE
 Date MSDS Prepared: 04MAY92
 Safety Data Review Date: 13SEP96
 Preparer's Company: RADIAN CORPORATION
 Preparer's St Or P. O. Box: 8501 NORTH MOPAC BLVD
 Preparer's City: AUSTIN
 Preparer's State: TX
 Preparer's Zip Code: 78720-1088
 MSDS Serial Number: CCDHR

 =====
 Ingredients/Identity Information
 =====

Proprietary: NO
 Ingredient: METHANOL (METHYL ALCOHOL), COLUMBIAN SPIRITS *96-3*
 Ingredient Sequence Number: 01
 Percent: 99.9
 NIOSH (RTECS) Number: PC1400000
 CAS Number: 67-56-1
 OSHA PEL: 200 PPM
 ACGIH TLV: 200 PPM
 Other Recommended Limit: 200 PPM

 Proprietary: NO
 Ingredient: DL-3,4-METHYLENEDIOXYMETHAMPHETAMINE
 Ingredient Sequence Number: 02
 Percent: 0.1
 NIOSH (RTECS) Number: 1014637DL

CAS Number: 54946-52-0

Physical/Chemical Characteristics

Appearance And Odor: WHITE SEMI-SOLID (DL-MDMA) IN CLEAR, COLORLESS LIQUID
W/SLIGHT ALCOHOLIC ODOR
Boiling Point: 148F
Melting Point: -144.4F
Vapor Pressure (MM Hg/70 F): 97
Vapor Density (Air=1): 1.11
Specific Gravity: 0.7913
Evaporation Rate And Ref: (BUTYL ACETATE=1): 5.9
Solubility In Water: COMPLETE

Fire and Explosion Hazard Data

Flash Point: 52F
Flash Point Method: CC
Lower Explosive Limit: 6
Upper Explosive Limit: 36.5
Extinguishing Media: DRY CHEMICAL, CO2/HALON EXTINGUISHER
Unusual Fire And Expl Hazrds: FLASHBACK ALONG, VAPOR TRAIL MAY OCCUR.

Reactivity Data

Stability: YES
Cond To Avoid (Stability): HEAT, SPARKS/OTHER SOURCES OF IGNITION. LIGHT MATERIALS TO AVOID: ACIDS, ACID CHLORIDES, ACID ANHYDRIDES, OXIDIZING AGENTS, REDUCING AGENTS & ALKALI METALS
Hazardous Decomp Products: CO, CO2, NITROGEN OXIDES
Hazardous Poly Occur: NO

Health Hazard Data

Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: YES
Health Haz Acute And Chronic: SKIN/EYES: EXPOSURE TO METHANOL MAY RESULT IN SEVERE SKIN & EYE IRRITATION, BLINDNESS & NARCOSIS. IT CAN BE ABSORBED THROUGH THE SKIN. MAY CAUSE BURNING SENSATION, EYE DAMAGE & CNS DEPRESSION.
EXPOSURE TO DL-3,4-METHYLENEDIOXYMETHAMPHETAMINE MAY CAUSE TOLERANCE & PHYSICAL DEPENDENCE, COMA/DEATH.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NONE
Signs/Symptoms Of Overexp: METHANOL: IRRITATION, NARCOSIS, BURNING, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA,

VOMITING, CONVULSIONS, FATIGUE, DROWSINESS. DL-3,4-METHLENE-DIOXYMETHAMPHETAMINE: TOLERANCE, PHYSICAL DEPENDENCE, COMA, VISUAL HALLUCINATIONS, CONFUSION, AGITATION, VENTRICULAR FIBRILLATION/HYPOTENSION. Emergency/First Aid Proc: INGESTION: GIVE LARGE QUANTITIES OF LIQUID & TRANSPORT TO MEDICAL FACILITY. SKIN/EYES: WASH W/LARGE AMOUNTS OF WATER. INHALATION: IF BREATHING IS DISTURBED, GIVE CPR WHILE TRANSPORTING. OBTAIN MEDICAL ATTENTION IN ALL CASES.

=====
Precautions for Safe Handling and Use
=====

Steps If Matl Released/Spill: REMOVE ALL IGNITION SOURCES. USE ABSORBENT PAPER TO PICK UP ALL MATERIAL. SOAK ABSORBENT PAPER IN AN APPROPRIATE SOLVENT SUCH AS TOLUENE/ALCOHOL TO PICK UP REMAINING TRACES. Waste Disposal Method: DISPOSE OF IN ACCORDANCE W/LOCAL, STATE & FEDERAL REGULATIONS. Precautions-Handling/Storing: STORE AT 32F. PROTECT FROM LIGHT. Other Precautions: AVOID INHALATION OF VAPORS. ONLY EXPERIENCED PERSONNEL SHOULD BE ALLOWED TO HANDLE THIS MATERIAL.

=====
Control Measures
=====

Respiratory Protection: CARTRIDGE TYPE RESPIRATOR W/ORGANIC VAPOR CARTRIDGES RECOMMENDED. Ventilation: LOCAL EXHAUST: USE W/FORCED VENTILATION. MECHANICAL (GENERAL) : NORMAL LABORATORY AIR EXCHANGE. Protective Gloves: POLYVINYL CHLORINE/NEOPRENE OVER LATEX Suppl. Safety & Health Data: INFORMATION FOR PHYSICAL DATA IS FOR METHANOL.

=====
Transportation Data
=====

=====
Disposal Data
=====

=====
Label Data
=====

URL for this msds <http://siri.org>.

MATERIAL SAFETY DATA SHEET

Date Printed: 04/30/2004

Date Updated: 04/10/2004

Version 1.3

Section 1 - Product and Company Information

Product Name	S(+)-3,4-MDMA HCl
Product Number	M139
Brand	SIGMA
Company	Sigma-Aldrich
Street Address	3050 Spruce Street
City, State, Zip, Country	SAINT LOUIS MO 63103 US
Technical Phone:	314 771 5765
Emergency Phone:	414 273 3850 Ext. 5996
Fax:	800 325 5052

Section 2 - Composition/Information on Ingredient

Substance Name	CAS #	SARA 313
S(+)-3,4-METHYLENEDIOXYMETHAMPHETAM INE CNS STIMULANT; HALLUCINOGEN	64057-70-1	No

Formula C₁₁H₁₅NO₂·HCl

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Highly Toxic (USA) Very Toxic (EU).

Very toxic by inhalation, in contact with skin and if swallowed.

Target organ(s): Central nervous system.

HMIS RATING

HEALTH: 3*

FLAMMABILITY: 0

REACTIVITY: 0

NFPA RATING

HEALTH: 3

FLAMMABILITY: 0

REACTIVITY: 0

*additional chronic hazards present.

For additional information on toxicity, please refer to Section 11.

Section 4 - First Aid Measures

ORAL EXPOSURE

If swallowed, wash out mouth with water provided person is conscious. Call a physician immediately.

INHALATION EXPOSURE

If inhaled, remove to fresh air. If not breathing give artificial respiration. If breathing is difficult, give oxygen.

DERMAL EXPOSURE

In case of skin contact, flush with copious amounts of water for at least 15 minutes. Remove contaminated clothing and shoes. Call a physician.

EYE EXPOSURE

In case of contact with eyes, flush with copious amounts of water for at least 15 minutes. Assure adequate flushing by separating the eyelids with fingers. Call a physician.

Section 5 - Fire Fighting Measures

FLASH POINT

N/A

AUTOIGNITION TEMP

N/A

FLAMMABILITY

N/A

EXTINGUISHING MEDIA

Suitable: Water spray. Carbon dioxide, dry chemical powder, or appropriate foam.

FIREFIGHTING

Protective Equipment: Wear self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes.
Specific Hazard(s): Emits toxic fumes under fire conditions.

Section 6 - Accidental Release Measures

PROCEDURE TO BE FOLLOWED IN CASE OF LEAK OR SPILL

Evacuate area.

PROCEDURE(S) OF PERSONAL PRECAUTION(S)

Wear self-contained breathing apparatus, rubber boots, and heavy rubber gloves.

METHODS FOR CLEANING UP

Sweep up, place in a bag and hold for waste disposal. Avoid raising dust. Ventilate area and wash spill site after material pickup is complete.

Section 7 - Handling and Storage

HANDLING

User Exposure: Do not breathe dust. Do not get in eyes, on skin, on clothing. Avoid prolonged or repeated exposure.

STORAGE

Suitable: Keep tightly closed.

Section 8 - Exposure Controls / PPE

ENGINEERING CONTROLS

Safety shower and eye bath. Use only in a chemical fume hood.

PERSONAL PROTECTIVE EQUIPMENT

Respiratory: Government approved respirator.
Hand: Compatible chemical-resistant gloves.
Eye: Chemical safety goggles.

GENERAL HYGIENE MEASURES

Wash contaminated clothing before reuse. Wash thoroughly after handling.

Section 9 - Physical/Chemical Properties

Appearance	Physical State: Solid	
Property	Value	At Temperature or Pressure
Molecular Weight	229.7 AMU	
pH	N/A	
BP/BP Range	N/A	
MP/MP Range	N/A	
Freezing Point	N/A	
Vapor Pressure	N/A	
Vapor Density	N/A	
Saturated Vapor Conc.	N/A	
SG/Density	N/A	
Bulk Density	N/A	
Odor Threshold	N/A	
Volatile%	N/A	
VOC Content	N/A	
Water Content	N/A	
Solvent Content	N/A	
Evaporation Rate	N/A	
Viscosity	N/A	
Surface Tension	N/A	
Partition Coefficient	N/A	
Decomposition Temp.	N/A	
Flash Point	N/A	
Explosion Limits	N/A	
Flammability	N/A	
Autoignition Temp	N/A	
Refractive Index	N/A	
Optical Rotation	N/A	
Miscellaneous Data	N/A	
Solubility	N/A	

N/A = not available

Section 10 - Stability and Reactivity

STABILITY

Stable: Stable.

Materials to Avoid: Strong oxidizing agents.

HAZARDOUS DECOMPOSITION PRODUCTS

Hazardous Decomposition Products: Carbon monoxide, Carbon dioxide, Nitrogen oxides.

HAZARDOUS POLYMERIZATION

Hazardous Polymerization: Will not occur

Section 11 - Toxicological Information

ROUTE OF EXPOSURE

Skin Contact: May cause skin irritation.

Skin Absorption: May be fatal if absorbed through skin.

Eye Contact: May cause eye irritation.

Inhalation: May be fatal if inhaled. Material may be irritating to mucous membranes and upper respiratory tract.

Ingestion: May be fatal if swallowed.

TARGET ORGAN(S) OR SYSTEM(S)

Central nervous system.

SIGNS AND SYMPTOMS OF EXPOSURE

Cardiovascular effects. May cause confusion, delirium, hallucinations, panic, convulsions, and coma. Exposure can cause: CNS stimulation.

TOXICITY DATA

Intraperitoneal Intraperitoneal

Rat Rat

49 MG/KG 49 MG/KG

LD50 LD50

Intraperitoneal Intraperitoneal

Mouse Mouse

97 MG/KG 97 MG/KG

LD50 LD50

Intravenous Intravenous

Dog Dog

14 MG/KG 14 MG/KG

LD50 LD50

Remarks: Behavioral:Convulsions or effect on seizure threshold.

Behavioral:Ataxia. Gastrointestinal:Nausea or vomiting.

Behavioral:Convulsions or effect on seizure threshold.

Behavioral:Ataxia. Gastrointestinal:Nausea or vomiting.

Intravenous Intravenous

Monkey Monkey

22 MG/KG 22 MG/KG

LD50 LD50

Remarks: Sense Organs and Special Senses (Nose, Eye, Ear, and Taste):Eye:Mydriasis (pupilliary dilation).

Behavioral:Convulsions or effect on seizure threshold. Lungs,

Thorax, or Respiration:Dyspnea. Sense Organs and Special Senses

(Nose, Eye, Ear, and Taste):Eye:Mydriasis (pupilliary dilation).

Behavioral:Convulsions or effect on seizure threshold. Lungs,

Thorax, or Respiration:Dyspnea.

Intraperitoneal Intraperitoneal

Guinea pig Guinea pig

98 MG/KG 98 MG/KG

LD50 LD50

Section 12 - Ecological Information

Section 13 - Disposal Considerations

APPROPRIATE METHOD OF DISPOSAL OF SUBSTANCE OR PREPARATION

Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. Observe all federal, state, and local environmental regulations.

Section 14 - Transport Information

DOT

Proper Shipping Name: Toxic solids, organic, n.o.s.
UN#: 2811
Class: 6.1
Packing Group: Packing Group II
Hazard Label: Toxic substances.
PIH: Not PIH

IATA

Proper Shipping Name: Toxic solid, organic, n.o.s.
IATA UN Number: 2811
Hazard Class: 6.1
Packing Group: II

Section 15 - Regulatory Information

EU ADDITIONAL CLASSIFICATION

Symbol of Danger: T+
Indication of Danger: Very toxic.
R: 26/27/28
Risk Statements: Very toxic by inhalation, in contact with skin and if swallowed.
S: 22 36/37/39 45
Safety Statements: Do not breathe dust. Wear suitable protective clothing, gloves, and eye/face protection. In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

US CLASSIFICATION AND LABEL TEXT

Indication of Danger: Highly Toxic (USA) Very Toxic (EU).
Risk Statements: Very toxic by inhalation, in contact with skin and if swallowed.
Safety Statements: Do not breathe dust. Wear suitable protective clothing, gloves, and eye/face protection. In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
US Statements: Target organ(s): Central nervous system.

UNITED STATES REGULATORY INFORMATION

SARA LISTED: No

CANADA REGULATORY INFORMATION

WHMIS Classification: This product has been classified in accordance with the hazard criteria of the CPR, and the MSDS contains all the information required by the CPR.
DSL: No
NDSL: No

Section 16 - Other Information

DISCLAIMER

For R&D use only. Not for drug, household or other uses.

WARRANTY

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Inc., shall not be held liable for any damage resulting from handling or from contact with the above product. See reverse side of invoice

Appendix 3. WPI Survey Sheet

(Front)

Please fill out this brief, confidential survey for my IQP. For #2 and #3, circle your choice. After completion, simply place it in the WPI mail slot.

1) Class Year: _____

2) Gender: Male Female

3) Have you ever tried the drug "Ecstasy" (MDMA): Yes No

(Back)

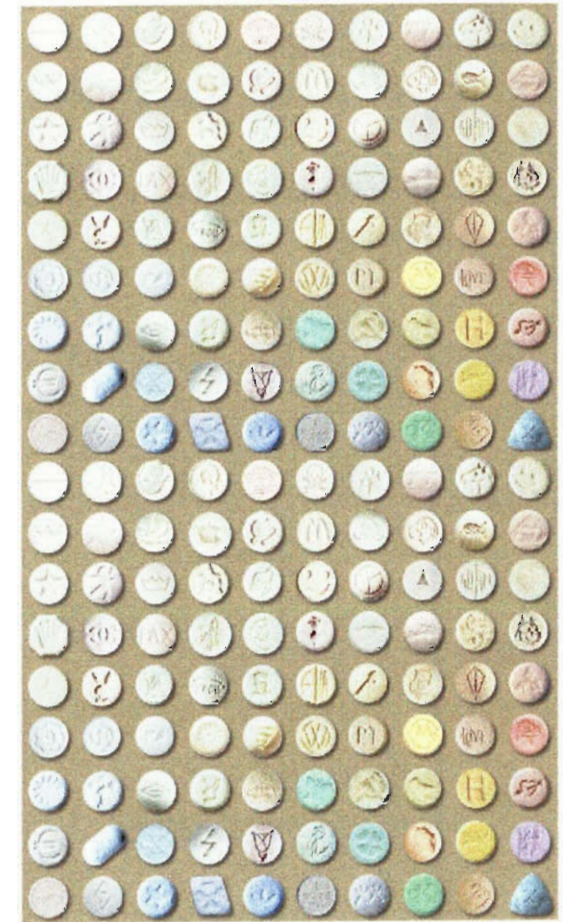
Tina Bramante
Box # 2897

The Experience

- ❑ Ecstasy takes 20 to 60 minutes to take effect when taken orally.
- ❑ The euphoric effects typically last 2 to 3 hours and during this time people like to dance, talk, and cuddle.
- ❑ Common side effects include dry mouth, jaw tension, teeth grinding, dilated pupils, and an inability to become sexually aroused. Rarely, some people experience visual hallucinations, nausea, or panic attacks.
- ❑ When coming down, some users feel tired, but others feel jittery. Relaxing activities like taking a bath or watching a movie can help.
- ❑ Aftereffects can last up to 1 week after use and include increased susceptibility to infections, depression, paranoia, decreased appetite and fatigue.

Knowing the Risks

- ❑ Allergies to MDMA are very rare.
- ❑ Seizures and fainting are signs of an MDMA overdose.
- ❑ Ecstasy causes 7 deaths annually, compared with 100,000 from tobacco and 35,000 from alcohol.
- ❑ The main causes of MDMA deaths are using it with other drugs and heat stroke.
- ❑ Symptoms of heat stroke include dizziness, vomiting, fainting, confusion, muscle cramps, and headache.
- ❑ Avoid heat stroke by taking breaks and drinking 2 to 4 cups of water per hour. Too much water can cause low blood salt. Also, wear loose clothing and no hat.
- ❑ If someone collapses, call an ambulance and attempt to cool him or her down. When caught early, heat stroke is treatable.



All About "E":
Unbiased Facts
About the Drug
Ecstasy

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