

# EFFECTS OF 3,4-METHYLENEDIOXYMETHAMPHETAMINE ON MEMORY IN HIGHER EDUCATION

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*ABSTRACT: MDMA is a psychoactive drug also known as ecstasy or the street name “molly”. (National Drug Intelligence Center, 2003). As the amount of raves and parties increases, the number of MDMA users are continuing to grow due to euphoria, hallucinogenic, and stimulant effects of the drug (National Drug Intelligence Center, 2003). In the first section, the author explores ways in which MDMA can affect the health of young adults at the University of Washington. Additionally, the research proposes a longitudinal experiment using a memory test to explore ways in which MDMA can affect the studies of students in higher education. This research paper will attempt to answer the question: Do college students who take MDMA have worse memory problems than those who do not?*

## Introduction

3,4-Methylenedioxymethamphetamine (MDMA) is a psychoactive drug also known as ecstasy or the street name “molly”. MDMA is a man made and illegal drug invented in early twentieth century Germany as an appetite suppressant (National Drug Intelligence Center, 2003). In 1970, the United States began using MDMA as a psychotherapeutic tool but the drug was not approved by the United States Federal Drug Administration; therefore, it did not undergo formal clinical trials (National Institute on Drug Abuse, 2006).

MDMA is mostly used at all night dance parties like raves and nightclubs and has become very popular. This drug is extremely popular for the hallucinogenic and stimulant effects (National Drug Intelligence Center, 2003). In a 2004 survey, more than 11 million people over the age of 12 used MDMA at least once in their lifetime (National Institute on Drug Abuse, 2006). MDMA affects the serotonin receptors and reduces the serotonin levels. When these receptors are affected, it could affect

negative things like aggression, mood, sexual activity, sleep, sensitivity to pain, and memory loss (Gowing et al., 2002). In addition to serotonin, MDMA can affect dopamine which can also affect movement, cognition, motivation and reward (Gowing et al., 2002).

Drugs like MDMA are attracted to cities like Seattle due to the large population of about 563,374 people in 2000, the easy access to the freeways, and popular rave dance events and clubs (Banta-Green et al., 2005). This paper will focus on college students at the University of Washington Seattle campus, ages 18 to 25 who take MDMA at raves or parties and the effects the drugs can have on students' memories. The question for my propose plan is: Do college students who take MDMA have worse memory problems than those who do not? The hypothesis is that college students who take MDMA have more memory problems than those who do not take MDMA because of the damaging brain effects.

MDMA is the third most commonly used illicit drug and causes many serious health

problems (Gowing et al., 2002). In 1995, the lifetime prevalence of ecstasy was only two percent, however in 2001, it increased to 13 percent, and is continuing to increase (Martin et al., 2005). Raves and dances were the one location where people who used MDMA were consistently and significantly affected (Banta-Green et al., 2005).

While using the dangerous drug, MDMA causes tension, involuntary teeth clenching, nausea, blurred vision, tremors, sweating, and even chills. Taking MDMA can be very dangerous since it can be mixed with many other drugs like heroin and methamphetamine which can sadly cause death (National Drug Intelligence Center, 2003). In a study, participants believed that MDMA encourages risky behaviors such as unprotected sex, and driving under the influence (Comis & Noto, 2012). While surveying people at raves, a study found that 38 percent of the users had unprotected sex, and were driving under the influence (Banta-Green et al., 2005).

Since MDMA can be found in many dance clubs, many people experience hyperthermia due to the loss of serotonin levels because of physical activity involve in dancing which causes body temperatures to lose control (Gowing et al., 2002). Hyperthermia is the most dangerous side effect along with severe adverse effects of MDMA (Shimane et al., 2013). Hyperthermia can also cause seizures, disseminated intravascular coagulation, rhabdomyolysis, renal and liver impairment (Gowing, 2002). There is evidence for causation that as body temperature rises that there is a risk in death. When someone's temperature is over 41.5 degrees Celsius, two thirds of the cases show that this can cause death (Gowing et al., 2002). Treatment of hyperthermia needs

medical attention right away because of muscles breaking down and kidney failure. However, after a single dose of ecstasy, liver damage can occur ranging from benign forms mimicking acute viral hepatitis to severe forms such as liver failure due to massive hepatic necrosis even without hyperthermia (Gowing et al., 2002).

Many users who have taken MDMA have said that stopping the use of MDMA was very difficult and they were all concerned that there would be future health problems if they continued to use MDMA (Banta-Green et al., 2005). Some long term effects of MDMA also include: insomnia, depression, headaches and muscle stiffness (Gowing et al., 2002). This is another serious problem of MDMA. This is because the drug affects the serotonin producing levels and these effects seem to be long-lasting when done on rats (MDMA, 2012). Depression and having a low mood are associated with the consumption of MDMA which can last up to a week after taking MDMA and can be even longer for those who have taken MDMA for a longer-term or a higher dosage (Gowing et al., 2002). Many people try to make MDMA "safer" by using vitamins like 5-hydroxytryptophan (5-HTP) to help with the depressant effects of MDMA (Banta-Green et al., 2005). Memory problems and lack of concentration are the most common effects and in a study, two participants with a heavy use of MDMA for a year or more, reported memory loss even after they stopped using ecstasy (Comis & Noto, 2012).

Many young adults continue to use MDMA at raves despite its negative effects. The average age of MDMA use is 21 years old and the majority of people were 18 to 21 years old (Riley et al., 2001). In Seattle, one

## Methods

of the most popular rave events is hosted by USC events who host sold out shows every month which include Freaknight, Resolution, and Paradiso and many people who attend these shows consume drugs. Recently in 2014, a young adult in Seattle died from the overdose of MDMA and people are constantly being sent to the emergency room (Kim, 2014). In a study, 24 MDMA users who had not taken the drug for two weeks, and 24 non-users who had never taken the drug, took a vocabulary test, and it was shown that the MDMA users had signs of impaired visuals and verbal memory (MDMA, 2012). With the negative effects of memory loss, and lack of concentration, students would often go back to class with these negative effects of MDMA which might possibly affect their ability to learn.

Use of MDMA has been associated with verbal memory deficits in abstinent users and recreational users (Van Wel et al., 2011). In a study, a male mouse with a high dosage of MDMA, caused persistent impairments in recall of operant alternation behavior, suggesting alterations in memory processing and reduced behavioral flexibility (Viñals et al., 2013). Using a total of 17 healthy MDMA users in a study, three different memory tests were done on the participants and it was shown that from one single dose of MDMA it produces memory impairments in all memory tasks (Van Wel et al., 2011). With the average age of MDMA users being from ages 18 to 21, and the memory impairments shown these studies, there is evidence that young adults are suffering from memory loss which could affect their ability to learn in higher education.

### Study Design

The study proposed would be a prospective longitudinal design. This design will assess the amount of MDMA students have taken and a memory test will be taken once a month for six months which will allow the research team to see the effects of MDMA on the participant's memory.

### Population

The population for this study will be 400 students from the University of Washington Seattle campus from ages 18 to 25 year olds who will take questionnaires. The questionnaires will include questions such as the number of MDMA they have taken in the past year, and how often they take MDMA. The question will split the students into two groups of students who have taken MDMA and students who have not.

### Sampling Methods and Process

The sampling method is quota sampling. This is a non-probability sampling because the groups will be split into groups of whether they have taken MDMA and whether they have not taken MDMA depending on their answers to the questionnaire. The study population will have the same proportions of individuals since there will be 200 students in each of the two groups.

Posters and flyers will be posted all around campus. The posters and flyers will include a phone number and email. The research will also be shared using social media daily and will also be shared by word of mouth. Once they have called, texted, or emailed, they will be sent with a short questionnaire about their experiences with MDMA within the last three months and from there, the student will be able to voluntarily join the research. There will be 200 students in

each group and will take a recall memory test every month for six months. Due to participant attrition, many participants may drop out during the research and therefore I will gather 50 more participants for each group.

### **Ethical Considerations**

Participation in this research study would be voluntary along with consent forms. The forms will include the proposed study design, sampling, and methods and will be reviewed for approval by the University of Washington Institutional Review Board (IRB). Personal information would be accessible to the researcher team and would be confidential to those who volunteer.

### **Measures and Variables**

The independent variable in this study would be the total of MDMA taken by the students. The amount of MDMA will be found using the questionnaire. The dependent variable in this study would be the memory test using a word list recall method. Users and non users will have a list of 20 words that would have to be memorized in 20 minutes. Some other important variables in this study are the other drugs and alcohol that is taken with MDMA like alcohol and marijuana which could play an impact on the memory test in the study. The questionnaire will ask other drugs and alcohol that is combined with MDMA during their time of use.

### **Procedures**

Researchers will go to the University of Washington Seattle campus and recruit two hundred students who will participate in a questionnaire determining whether they have ever taken MDMA within the last year and how much MDMA was taken in the last year. The questionnaire will also make

sure that the participants involved are young adults who are in a healthy condition. This will make sure that the participants from any psychotropic medication, have not had any psychiatric or neurological disorder, pregnant, or drink or smoke excessively. The participants will then take a memory recall test. This will have 20 words that the participants will need to memorize within 20 minutes. Once it has been 20 minutes, the participants will write down the words that they remember from the list of words. Each word will be half a point. The higher the points and the more words that the participants the better the score. Each of the scores will be compared by the amount of MDMA that the participants have taken. The test will be taken every month for six months along with a questionnaire to ask if the participants have taken any more MDMA within the last month of the last memory recall test.

### **Analysis**

The data collection will be a quantitative analysis using the scores from the recall memory test. The questionnaire will ask how much MDMA the participants have taken which and the researchers will then take the memory test to see if the MDMA affects their memory. The memory test will have a score from one to ten. Ten being excellent memory and one being poor memory. This study is bivariate and will have two variables which are participants who take MDMA and participants who do not, and how much MDMA participants have taken over the course of time.

## Discussion

### Significance and Implications

The significance of this study is to see how MDMA can affect a student's memory which could also affect their learning ability. The survey will allow researchers to see how much MDMA students are taking and how many students are using this drug. The data in this study will allow students and universities to be aware of the potential harm of MDMA and possibly decrease the use of MDMA in young adults or promote awareness for these young adults in higher educations.

### Concerns and Limitations

Loss of follow up would be one of the limitations for any longitudinal study. Since this study will be for six months this will mean that participants will leave voluntarily due to many reasons. Another limitation is the cost of the study, since longitudinal study are more expensive since they go for a long time and because of the number of participants involved in this study. One concern with this study is since it is a prospective, many students will not be able to remember how many times they have taken MDMA and how much MDMA they have taken over the past year.

Some confounding variables in this experiment is that MDMA is often mixed with other drugs like meth and cocaine, and buyers often do not know what they are taking most of the time. Many people who take MDMA also mix with many other drugs like alcohol or marijuana which could then affect the accuracy of the memory test. Another concern in the study is that drug dealers are measuring less MDMA in order to profit. Many participants will be taking less MDMA than what they really thought

they are taking which causes inaccurate data. Furthermore, participants who take more MDMA within the six months of the study will be excluded from the study.

### Directions for Future Research

MDMA has increased not only in Washington, but in many other states and young adults in higher education are taking this dangerous drug especially in California where electronic dance music events are popular and where many other popular events like Coachella and Electric Dance Festival is held. The study would be a longer longitudinal study in order to study the longer term of memory effects of MDMA. The future research design would also allow the researchers to control the amount of MDMA and will only MDMA without any other drugs or alcohol that will affect memory. Participants will also take pure MDMA which may have some ethical concerns. Lastly, a larger quantity of students will be studied.

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