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Impacts of Drug Use on Memory

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Abstract: Purpose: To study the consequences of chronic drug use on human's cognitive functions. Methods/Procedures: Review of scientific studies. New Results: Chronic drug use indeed impacts negatively on human's cognitive functions, especially in terms of attention, learning, and memory. With increasing amount of certain drug use, the degree of impairments also increases. It is unsure if the memory deficits that result from drug abuse persist forever as study examining memory impairments after more than a month's abstinence of drug use is not found. Conclusion: Therefore, it is incorrect to say that drug users or ex-drug users are incapable of learning; instead, as a result of neurological changes in the brain caused by chronic drug use, learning may take more time and effort for them as compared to non-drug users.

Key words: drugs, memory, cognitive functions.

INTRODUCTION

The initial motif of the creation of drugs is to benefit humans; for instance, to get rid of physical illness or to work as anesthesia during surgery. Specifically, marijuana is reported to be prescribed for alleviating pain from cancer, for minimizing nausea from chemotherapy, for diminishing the wasting syndrome of AIDS, and also used in the treatment of epilepsy, glaucoma, multiple sclerosis and few other disorders (Ogborne *et al*,2000). In Ogborne and colleague's self-reported survey with the sample of 2,508 adults, 1.9% reported using marijuana for medical reason especially pain or nausea while 6.8 reported using marijuana for non-medical reasons. Stimulants like ecstasy shows promising results in treating psychological problems like attention deficit hyperactivity disorder (ADHD; McCabe *et al*, 2006). However, it was reported that more undergraduates abused stimulant than using it medically (McCabe *et al*, 2006).

Hence, unfortunately, drugs designed to benefit humans medically have been misused to obtain momentary happiness. Drugs contribute to undesirable consequences when misused regularly or addicted. One of the many negative effects of drug abuse is cognitive impairments, especially in learning and memory. In the current paper, several investigations of the effects of drug abuse in terms of learning and memory would be discussed (Quednow *et al*, 2006; Roberts *et al*, 2009). This review is needed especially for people involved in the rehabilitation work of ex-drug users. The authors noticed from rehabilitation center that the clients were always condemned for forgetting stuff or slow in learning while the clients showed helplessness. Question arises if this is the consequence of drug use or the client was merely not paying attention.

Ecstasy:

Among the drugs abused, ecstasy is one of the most frequently studied. For instance, learning and memory impairment in ecstasy abusers were studied by comparison between 20 ecstasy users and 20 non-drug users (Roberts *et al*, 2009). The ecstasy users were abstained from the use of other illicit drugs for at least 10 weeks and ecstasy for at least 48 hours prior to the testing. This is carried out to eliminate or minimize the acute or residual effects of drugs, hence assessing persistent effects of chronic ecstasy use on learning and memory as intended. Participants were required to study the numbers matched with faces and later recall the number when shown with the faces. The findings show ecstasy users to perform worse than non-drug users in the face recognition task, indicating worse learning and memory capability. Another study (Quednow *et al*, 2006) comparing 19 ecstasy user and 19 non-drug users using verbal learning task (words read out to participants) instead of facial learning task found similar results; ecstasy users performed worse than non-drug users. The study also shows ecstasy users to have weaker information organization, as displayed in a high inconsistency of recall (able to recall a learnt word in a trial but not the next) as well as strong retroactive interference (detrimental effect on previously learnt word as a result of learning new material), as displayed in a high loss after interference. In addition, the study also revealed significant relationship between amount of ecstasy taken and memory performance. Therefore, studies have shown chronic use of ecstasy to be associated with

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impairment in verbal and visual memory, with a positive relationship between greater amount of ecstasy use and higher degree of impairment.

Furthermore, a study (Bolla *et al*, 1998) in which comparisons were made between 24 ecstasy abusers and 24 non-ecstasy abusers were conducted and it was also found that ecstasy users had deficits in visual and verbal memory. The higher the average monthly doses of ecstasy, the greater the decrements in memory functions. The study also revealed baseline intelligence to be related to the degree of decrement in memory as a result of doses of ecstasy. Specifically, for the same monthly dose of Ecstasy taken, an individual with lower baseline intelligence would suffer more than another individual with higher baseline intelligence in terms of memory. Hence, this study further validated the findings of the abovementioned two studies that ecstasy use influences verbal and visual memory and that the influence is related to the amount of ecstasy intake.

Other than ecstasy, impact of other drugs on human's memory was also investigated. For example, a study (Bolla *et al*, 2002) examining the effects of marijuana use were administered among 22 marijuana abusers who used marijuana for at least two years and aged 18 to 37 years old. Consumption of marijuana ranged from 2 to 117 joints per week. A battery of tests measuring different domains of cognitive functions was administered after 28 days of abstinence from marijuana among the participants and results show that as joints smoked per week increased, performance on tests examining verbal memory, visual learning and memory, executive functioning, psychomotor speed, and manual dexterity decreased. When duration of use was assessed, it was found to be associated only to one domain of cognitive functions; that is, as duration of use increases, visuoperception capability decreases. Besides, when the scores of heavy users (78–117 joints per week) were compared to published age-appropriate normative values for the tests, scores were found to be clinically below the norm for tests of executive functioning, visual memory, and manual dexterity. Hence, similar to the effect of ecstasy use, this study shows marijuana use to be related to verbal memory and visual memory deficits, with greater amount of marijuana use associated with higher degree of deficits.

Cocaine:

Studies were also conducted to examine the possible cognitive impacts of cocaine use. A study (Bolla *et al*, 1999) similar to the above was conducted among 30 chronic cocaine abusers who were abstained from any drugs for 30 days before being tested with a battery of neurocognitive tests. The cocaine abusers were then divided into two groups according to consumption of cocaine per week: low cocaine (below 2 grams) and high cocaine (equal to or more than 2 grams). Findings show high cocaine group to perform worse than low cocaine group in tests of verbal memory, executive functioning inclusive of attention, planning and mental flexibility, visuoperception, psychomotor speed, and manual dexterity. Thus, cocaine use is also related to memory impairment with greater intensity of cocaine use associated with greater degree of impairment.

Ketamine:

During recent years, there is a growing illegal use of ketamine. Hence, researchers have put in efforts in studies in order to examine the negative consequences of the use especially in terms of cognitive functions. For instance, comparisons were made between 20 chronic ketamine users and 20 matched control participants (Morgan *et al*, 2004). The respondents were tested on episodic memory on the night and after three days the ketamine was taken. Episodic memory requires one to remember not only having learnt about something, but also remembering the source of the information learnt. An example of episodic memory in daily life would be to recognize a person's face while remembering where and when the individual met this face. The respondents in the study were not allowed to take any recreational drugs during the period between the two testing. The results analyses show ketamine users to display memory impairments on both days while control group only showed memory impairment on the first testing. The persisting memory impairment among ketamine users could not be the residual effects of ketamine as ketamine has very short half-life and if it was the residual effect, the memory impairment would have been noticed in control group in the second testing as well. Hence, the study shows ketamine to produce persisting deficit in episodic memory.

Ecstasy and Cannabis:

With the advancing technology, a web-based survey (Rodgers *et al*, 2003) involving 763 respondents (37% had used ecstasy for at least once; 41% used cannabis for at least 1–4 times per month while 2 resisted answering) was carried out to examine the impact of ecstasy and cannabis on memory. One of the advantages of using web-based survey is that the respondents feel less pressured while answering questions, regarding drug use especially, as the investigators have not seen them in person. This consequently increases the reliability of the study's findings. In this survey, Everyday Memory Questionnaire (EMQ), a valid and reliable self-report questionnaire, was used to assess respondents' memory capability in everyday life. Examples of questions include 'finding a television story difficult to follow' and 'forgetting where things are normally kept or looking in the wrong place for them'. In addition, Prospective Memory Questionnaire's (PMQ) long-term episodic subscale was used and an example of question is 'I forgot to pass on a message to someone'. This scale is used

to measure respondents' capability in remembering to perform intended action instead of remembering past incidences or experiences. This study reveals that cannabis and ecstasy affect abusers' memory differently. Specifically, frequency of cannabis use influences one's everyday memory while the amount of ecstasy use influences long-term episodic prospective memory and number of errors made while filling in the web-based questionnaire; that is, missed answering one or more questions.

Real Life Practices:

Other than using standardized neuropsychological tests, investigations were also made using real life practices. For example, Martins and Alexandre (Martins *et al*, 2009) made comparisons among adolescents with ecstasy use, marijuana use (without ecstasy use), alcohol/tobacco use (without other drug use), and non-drug users in terms of academic performance in two samples (2002–2005 National Survey of Drug Use and Health involving 65, 294 participants and 2001–2003 Youth Risk Behaviour Survey involving 27, 592 participants). The findings showed the first three groups to be associated with moderate and low academic performance. Furthermore, ecstasy use was found to be more strongly associated with low academic performance than alcohol/tobacco use in two samples and marijuana use in the first sample. Therefore, examinations of the influences of drug use using real life practices also prove drug use to be associated with learning and memory.

Review of Scientific Studies:

Many investigations have been carried out to examine the consequences of use of distinctive drugs in different aspects of cognitive functions. As a result, several conclusions of memory impacts of drugs have been made by several groups of researchers. Therefore, some experts gather related scientific studies and come to a conclusion of the impacts of drug use according to the review of the studies. After reviewing several brain imaging and neuropsychological research examining cognitive consequences of drug use in terms of attention, memory and executive functions, Lundqvist (Lundqvist, 2005) drew a conclusion that with the possible exception of heroin, all drugs cause dissonance in human's neuropsychological network, causing negative effect such as impaired short-term memory and attention. According to this review, heavy cannabis use is correlated with reduced learning, problems in shifting and/or sustaining attention, decreased mental flexibility, and increased preservation. Besides, cocaine use is found to be linked with deficits in attention, learning, memory, reaction time and cognitive flexibility. Amphetamine/methamphetamine, on the other hand, is associated with impairments in learning, delayed recall, working memory, and processing speed. Furthermore, ecstasy is found in studies to be linked with impaired verbal learning, more easily distracted, and inefficiency in focusing concentration on complex tasks. The review also found the link between severity of drug use and the degree of impairment, with higher intensity of drug use to be associated with more severe impairments. Unfortunately, the examination of previous investigations also found the impairments to be relatively lasting over time, even after a period of drug abstinence.

Conclusion:

Drawing a conclusion from the abovementioned investigations, drug abuse indeed impacts negatively on human's cognitive functions, especially in terms of attention, learning, and memory. These three domains are interrelated as one needs to focus on tasks on hand in order to learn and to store them in memory for future retrieval. Hence, it is no surprise that when one is having deficit in one of the three domains, he or she would have difficulty performing in areas involving knowledge or skills acquisition such as in academic work or remembering places where one put certain things. However, the findings of the abovementioned studies should be reviewed with caution as study examining the cognitive or memory impairments after more than a month's abstinence of drug use is not found. Therefore, it is unsure if the memory deficits that result from drug abuse persist forever. In short, it is incorrect to say that drug users or ex-drug users are incapable of learning; instead, as a result of neurological changes in the brain caused by chronic drug use, learning may take more time and effort for them as compared to non-drug users.

Implication:

Utilizing the current review's findings, related parties like government agencies and non-government organization could plan and implement their precautions and intervention accordingly. Specifically, a case worker in a rehabilitation center should be more understanding when clients are forgetful while exposed to a new task or new environment. For instance, a client may need longer time like months to be adapted to the routine that he or she is on duty to prepare for dinner on every Monday. In terms of academic, a client may need tons of revisions of the same batch of words before proceeding to new words in order for him or her to truly acquire the words. While Foo and colleagues' (2012) study found an individuals' drug abuse to be usually caused by a combination of factors that require individualized intervention, this review adds that the intervention should be plotted according to the degree of cognitive impairment as a result of drug use too. That

is, an individual with more intense amount of drug use (more severe cognitive impairment) would need plan with bigger portion/time for learning.

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