Prolonged Abstinence from Drugs and Alcohol: Effects on Working Memory and Self-esteem

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ABSTRACT

Many drugs of abuse are known to have negative effects on working memory, and long-term abstinence is associated with improvements in cognitive function. The purpose of the study was to determine if length of abstinence from drugs and alcohol affected working memory capacity and level of self-esteem. Participants consisted of a short-term recovery group currently receiving treatment, a long-term recovery group, and a control group with no history of substance abuse. The only significant effect found was the positive correlation between working memory capacity or self-esteem, and there were no differences between those with and without a history of substance abuse for working memory and self-esteem.

Introduction

Addiction is a disease in which a person becomes physically and psychologically dependent on a drug (Advokat, Comaty, & Julien, 2014). Drugs of abuse are psychoactive substances, meaning they alter users’ state of mind. They are classified into several categories based on the effect they produce (for example, opioids, sedative hypnotics, and ethyl alcohol). Following chronic abuse of a drug, a person enters a state of physical dependence that results in tolerance to the drug, requiring more to reach the same effect. Physical dependence is also marked by withdrawal symptoms once use is halted, such as sweating, vomiting, and in severe cases, hallucinations. Chronic drug abuse also leads to psychological dependence, which is marked by drug seeking behavior, requiring the drug to function normally, and continued use of the drug even when the consequences outweigh the benefits. A meta-analysis of long-term alcohol abuse found significant effects across eleven cognitive domains (Stavro, Pelletier, & Potvin, 2013).

Addiction is a global problem with an estimated 15.3 million persons who have drug use disorders (World Health Organization, 2014). Drug addiction is particularly prevalent in the United States, with an estimated 22.7 million Americans who required treatment for drugs or alcohol in 2013 (National Institute on Drug Abuse). Several studies indicate a trend toward higher levels of drug use and dependency at a younger age. For example, a study on college students’ marijuana and alcohol use in the United States found that 52% of individuals between the ages of 18-25 reported using marijuana at least once in their lifetime, 31% had used in the past 12 months, and 21% within the past month (Meda et al., 2017). Of the students that had used at least once, 58% said they had used both alcohol and marijuana at the same time. Higher levels of experimentation with drugs may lead to higher levels of overdose or addiction. If a
person becomes addicted to the drugs they are experimenting with, they may eventually end up in treatment.

Recovery is a phase of addiction when a person remains abstinent from drugs and alcohol. Recovery looks different for every person; a person may achieve abstinence on their own, they may attend treatment once, or they may attend treatment several times. A person can go to treatment voluntarily or involuntarily. Each treatment program is different, but they all have the same end goal. All programs have some form of individualized therapy, group therapy, and a form of behavioral therapy that focuses on strategies to change current behavior to prevent future relapse (Harris, Smock, & Wilkes, 2011). Before leaving treatment, they will make a relapse prevention plan. Their plan for remaining abstinent from drugs and alcohol will entail strategies that will help them cope with stressful situations once they return home. These strategies are a very important part of successful recovery because relapse is common in recovery. Relapse occurs when a person who is abstinent from drugs and alcohol for a period starts using again, and a person may remain abstinent for several days to years and then start using again (McIntosh & McKegany, 2000).

**Working Memory**

Excessive use of drugs and alcohol leads to deficits in memory and inhibitory control (Farhadian, Akbarfahimi, Abharian, Hosseini, & Shokri, 2017), as well as decision making (Wollenweber et al., 2014). Each time a person relapses, the impact on memory becomes greater. Working memory is a form of short-term memory where information is only able to stay for the duration that it remains at the focus of attention (McBride & Cutting, 2016). Attention is another form of short-term memory, which is characterized by certain patterns of memory storage where each time one encounters a new stimulus, it enters the sensory memory where it is held for a brief few seconds and then is passed along into working memory. It controls the information in focus, which is then passed on to long-term memory, where the memories in long-term storage are replaced by new information. Working memory is regulated by the central executive, one of the three main components of working memory (Baddeley, 1996). The central executive helps one focus on task-relevant information and ignore task-irrelevant information.

Numerous studies have shown that drugs and alcohol have significant impacts on working memory. Persons who chronically used cocaine had significantly lower working memory and attentional capacity than their matched controls (Jovanovski, Erb, & Zakzanis, 2005). One study found that when heavy alcohol users consumed low doses of alcohol, their working memory wasn’t significantly affected, but there was a significant decrease in working memory performance when they consumed doses of alcohol that matched their own drinking behaviors (Lechner, Day, Metrik, Leventhal, & Kahler, 2016). In another study, students who were found to have been heavy users of both alcohol and marijuana experienced deficits in memory and lower GPAs. Other research has shown that methamphetamine (Farhadian et al., 2017) and heroin (Oliveira et al., 2016) also have negative effects on working memory. These studies and others suggest that there is a strong correlation between memory and drug usage.
Abstinence and Working Memory

Despite the negative correlations between memory and drug abuse, there is still a chance for recovery, as prolonged abstinence can lead to improvements in cognitive function (Seifert et al., 2003; Henry, Mazur & Rendell, 2009). Working memory improves with short-term abstinence from alcohol (Petit et al., 2017), while longer abstinence is required to show improvements for those who chronically abuse methamphetamine (Farhadian et al., 2017). However, the rate at which it can improve is dependent on length of use and length of abstinence. Former heroin users undergoing methadone maintenance showed that those who were in a community-based abstinence program showed a greater increase in working memory than those in the low-threshold program, which did not require abstinence from drugs or alcohol (Oliveira et al., 2016). Those who could remain abstinent from methamphetamine for the 13-month time frame between measures showed an overall improvement in working memory and other cognitive functions in relation to length of abstinence (Iudicello et al., 2010).

Self-esteem

Along with working memory, chronic drug abuse has been found to effect self-esteem, where persons with alcohol use disorder reported decreased levels of self-esteem in the beginning stages of treatment (Luquien et al., 2016). Self-esteem is the view and sense of value a person has about themselves. Self-esteem is determined by the actions one makes, whether they consider those actions to be morally right or wrong, and how they believe others would judge their actions (Alavi, 2011).

The way people experience and feel the perceptions of others is known as contingent self-esteem. This type of self-esteem is based on the perceived expectations of others. Events such as performance in academics or sports are good examples of when contingent self-esteem plays a large role in forming self-esteem (Crocker & Wolfe, 2001). Those with high contingent self-esteem tend to feel incompetent or shameful when they perform poorly; thus, they put great effort into maintaining their high self-esteem (Kernis, 2003). However, Kernis suggested that those who have high contingent self-esteem and fail to meet those perceived expectations may turn to alcohol or drug abuse to deal with the feelings of incompetence or shame. Several studies have shown that university students with low self-esteem consume higher levels of alcohol (Sadava & Pak, 1993; Schall, Kemeny, & Maltzman, 1992), as well as higher levels of sedative use for men and higher levels of marijuana and opiate use for women (Peltzer & Malaka, 2001). Persons who abused alcohol during a methadone treatment program who were still using found it hard to talk about their dependence and had lower levels of self-esteem (Rengade, Kahn, & Schwan, 2009). Therefore, lower levels of self-esteem may lead to an increase in substance abuse, which then leads to a decrease in working memory function.

Aim of Study

Though several studies have shown improvement in working memory through prolonged abstinence, there are few studies that test working memory in both short- and long-term abstinence. Further, even fewer studies span more than one substance. Since self-esteem may play a role in whether a person turns to alcohol or drugs to cope with stressful events or negative
emotions, it is important to evaluate the relationship between length of abstinence and self-esteem, as no studies have been done to date. Thus, the purpose of this study was to test the working memory of persons with a history substance abuse whom are in short- and long-term recovery. Further, the goal of this study was to determine if self-esteem is correlated with length of abstinence, and to determine if self-esteem is a key factor in long-term abstinence.

Research has shown that memory starts to improve within the first few weeks of abstinence for persons dependent on alcohol (Petit et al., 2017), and within the first year for persons dependent on methamphetamine (Iudicello et al., 2010). Research has also shown that persons who continued to use while in treatment reported lower levels of self-esteem than those who remained abstinent (Rengade et al., 2009). Therefore, it was predicted that participants with longer spans of abstinence will score higher on the working memory span task and will have higher levels of self-esteem than participants with shorter spans of abstinence. It was also predicted that self-esteem will play a key role in long-term recovery.

Method

Participants

Participants consisted of three groups. Participants in group 3 (control) were 29 students from Psychology 101 at the University of Wisconsin – Superior (Males=8, Transgender Males = 2, Females=16). Participants in group 1 were recruited from the Center for Alcohol and Drug Treatment (CADT) in Duluth, MN. Participants from CADT were recruited from two of the residential treatment centers, one men’s and one women’s (M= 2, F= 8). Participants in group 2 consist of members of Alcoholics Anonymous (AA) (M= 5, F= 7). Inclusion criteria for groups 1 and 2 are that participants were 18 years of age or older and abstinent from both drugs and alcohol for at least 24 hours at the time of the study. Participants from CADT were between the ages of 26-55; members of AA were between the ages of 18-70; and participants in the control group were between the ages of 18-25, with one between the ages of 36-45. Participants in groups 1 and 2 who completed the study were put into a drawing to win a gift card following the conclusion of the study. Participants from the Psychology 101 class were given partial credit.

Materials

Demographic survey. The demographic survey is a 6-question survey which asks participants general demographic information (e.g., age, gender), as well as questions about their history of substance abuse (see Appendix A).

Drug Abuse Screening Test. The Drug Abuse Screening Test (DAST) (Addictive Behaviors, 1982) is a 28-item measure used to screen for a history of substance abuse (see Appendix B), including several reverse scored items. The DAST values each question a one point, with a cutoff score 6 used to indicate a drug abuse problem. The measure has excellent internal consistency (Cronbach’s $\alpha = .92$) and construct validity (Skinner, 1982).

Rosenberg Self-Esteem Scale. The Rosenberg Self-Esteem Scale (Society and the adolescent self-image, 1965) is a 10-item measure used to assess self-esteem on a 4-point Likert
scale, which includes several reverse scored items. The measure has good internal consistency (Cronbach’s $\alpha = .88$) and test-retest reliability (.82) was also good (Fleming & Courtney, 1984).

**Operation Span Measure.** The Operation Span Measure (Journal of Learning Disabilities, 2010) is a tool that measures working memory, in which participants complete several basic math problems (e.g., $4 + 3$) while trying to remember one-syllable words in the order given to them. There are five levels, and as they move to the next consecutive level, an additional math problem and word are added. The measure has good internal consistency (Cronbach’s $\alpha = .80$) (Swanson, Kehler, and Jerman, 2010).

**Procedure**

Participants first completed a demographic survey. Participants were directed to continue with the survey if they answered “yes” to question 3, asking, “do you have a history of substance abuse?” If they respond “no,” they were done with the demographic survey. Participants in the control group then completed the DAST. Prior to completing the DAST, participants were informed that answering “yes” to several of the questions does not signify a drug abuse problem, thus they should answer the questions as honestly as possible. All participants then filled out the Rosenberg Self-Esteem Scale, and completed the study with the Operation Span Measure. Participants were walked through the practice level of the Operation Span Measure. After they were instructed to write down the answer to the first math problem, they were given the first one-syllable word and told to remember it. Participants were then given the second math problem and instructed to write the answer down, followed by the second one-syllable word. Participants were then instructed to write down both words in the order they were given. The researcher assured there were no questions following the first set, and then proceeded with the working memory test.

**Results**

Participants consisted of clients of the Center for Alcohol and Drug Treatment (CADT), members of Alcoholics Anonymous (AA), and a control group. Participants in the control group were Psych 101 students. Participants in the control group were screened with the Drug Abuse Screening Test to assure they did not qualify for a substance abuse problem.

One participant in the control group did qualify for a substance abuse problem, and since they reported a length of sobriety, their data was put in with the AA group’s. Data for one participant from the control group was thrown out because they did not follow the directions for the working memory task.

**Rosenberg Self-Esteem Survey**

The hypotheses for the present study were as follows: a longer span of abstinence from drugs and alcohol correlated with higher performance on the working memory task; a longer span of abstinence correlated with higher levels of self-esteem; and that self-esteem would play a key role in long-term recovery. All tests were run using $\alpha = .05$. 
There was no significant relationship between length of abuse, length of abstinence, and working memory ($R^2 = .055, F(2, 19) = .551, p > .05$). Length of abuse did not predict working memory performance ($\beta = .163, p = .494$), nor did length of abstinence ($\beta = .127, p = .594$).

There was not significant relationship between length of abuse, length of abstinence, and self-esteem ($R^2 = .047, F(2, 19) = .468, p > .05$). Length of abuse did not predict one’s level of self-esteem ($\beta = .030, p = .901$), nor did length of abstinence ($\beta = .206, p = .390$).

Participants with a history of addiction and those with no history of addiction did not differ significantly on the working memory task, $t(46) = -.739, p = .719$. The results also showed that participants with a history of addiction and those with no history of addiction did not differ significantly on level of self-esteem, $t(46) = -.195, p = .619$.

There was a significant positive correlation between working memory and self-esteem, $r = .337, p = .019$. Persons with a higher level of self-esteem had correspondingly higher levels on the working memory task.

**Discussion**

The purpose of this study was to test the working memory of persons with a history substance abuse who are in short- and long-term recovery. Further, the goal of this study was to determine if self-esteem is correlated with length of abstinence, and to determine if self-esteem is a key factor in long-term abstinence.

The goal of the first research question was to determine if length of abstinence influenced working memory capacity. Previous research shows that chronic abuse of drugs (Farhadian et al., 2017; Oliveira et al., 2016; Jovanovski et al., 2005) and alcohol (Lechner et al., 2016) leads to deficits in working memory capacity. The findings were inconsistent with previous research on working memory in abstinence, which suggested that memory can recover with short-term abstinence from alcohol (Petit et al., 2017, and with long-term abstinence from drugs such as methamphetamine (Farhadian et al., 2017). The possibility of ceiling effects in the working memory test will be discussed later.

The goal of the second research question was to determine if length of abstinence influenced one’s level of self-esteem. Kernis (2003) suggested that persons who have high contingent self-esteem may turn to drugs or alcohol if they feel like they failed to meet those expectations. No significant differences were found between those in short- and long-term recovery. The participants in short-term recovery were in residential treatment during the time of the study; these findings were inconsistent with some previous research that found lower levels of self-esteem in the beginning stages of treatment (Luquiens et al., 2016). Other research has found no change of self-esteem following three months of treatment in a group of people experiencing homelessness (Malcolm, 2004). Further studies have found that persons in treatment for substance use disorder who reported low levels of self-esteem did not use treatment to their advantage (Corrigan, 2007), had a higher chance of relapse and a lower chance of recovery (Perlick et al., 2001). This could help to explain why self-esteem may have be higher for the participants in the present study. They were either still currently in treatment and felt
confident in their recovery, or their longer length of abstinence was influenced by their high self-esteem.

No differences were found between the control participants and the participants with addiction, which is inconsistent with previous research. Previous research indicates that memory declines with excessive use of drugs and alcohol, and declines further each time a person relapses (Wollenweber et al., 2014).

There was a positive correlation between self-esteem and working memory. This could be explained by the association between low self-esteem and depression (Pavlickova, Turnbull, & Bentall, 2014), anxiety (Schreiber, Bohn, Aderka, Stangier, & Steil, 2012), and rumination (Kuster, Orth, & Meier, 2012). Depression negatively influences auditory memory, visual memory, and visual working memory (Pauls, Petermann, & Lepach, 2013); generalized anxiety disorder (Moon, Sundaram, Choi, & Jeong, 2016) and rumination (Curci, Lanciano, Soleti, & Rimé, 2013) are associated with deficits in working memory.

A limitation of the study was the ceiling effect of the working memory test. Two measures that could be used in place of the Operation Span Measure are the Wechsler Adult Intelligence Scale – Fourth Edition (WAIS–IV; Pearson Assessments, 2009; Cronbach’s α = .90) or the Working Memory Battery (WOMBAT; Assessment, 2014; Cronbach’s α = .90). A second limitation was having limited information on the specific pattern of use. The study did not measure the frequency of use or amount used per day, which could be an important indicator of working memory performance.

Implications for future research include looking at effective ways to increase self-esteem in treatment, examination of individual differences in the impact of addiction on working memory, and how psychiatric medications affect memory. Persons with substance use disorders are often prescribed psychiatric medication to help with withdrawal and/or dual diagnoses (Pettinati, O’Brien, & Dundon, 2013). Several medications that people in recovery are frequently prescribed have been found to have negative impacts on memory, such as sertraline (Carpenter, Brooks, Vosburg, & Nunes, 2004), topiramate (Raguraman, Priyadharshini, & Chandrasekaran, 2005), and clonazepam (Trudeau, 1994). However, the studies only test one medication at a time. Polysubstance prescription (polypharmacy) has increased rapidly over the years in the general population, with a 17.8% increase in two or more medications from 1997-2006, and an increase of 16.3% with persons prescribed three or more medications (Mojtabai & Olfson, 2010). Currently, there is limited research on the frequency of polypharmacy in recovery populations. Therefore, it is important to explore the possible effects of polypharmacy and working memory in both general populations and for people in recovery.
Works Cited


