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Working Memory and Long-Term Abstinence from Substance Use

Larry E. Jasper

George Fox University, ljasper09@georgefox.edu

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Working Memory and Long-Term Abstinence from Substance Use

by

Larry E. Jasper

Presented to the Faculty of the
Graduate Department of Clinical Psychology
George Fox University
in partial fulfillment
of the requirements for the degree of
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in Clinical Psychology

Newberg, Oregon

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Working Memory and Long-Term Abstinence from Substance Use

Larry E. Jasper, MA

has been approved

at the

Graduate Department of Clinical Psychology

George Fox University

Approval

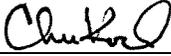
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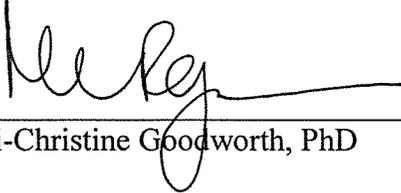
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Members:



Chris Koch, PhD

Feb 3, 2016
Date



Mari-Christine Goodworth, PhD

2/3/2016
Date

Working Memory and Long-Term Abstinence from Substance Use

Larry E. Jasper

Graduate Department of Clinical Psychology at

George Fox University

Newberg, Oregon

Abstract

Cognitive impairment is a well-established consequence of long-term substance abuse, with stimulant and polysubstance abuse leading to the most detrimental deficits, especially in the area of executive function. The extent of brain function recovery with long-term abstinence from substance use is less understood. Is cognitive impairment permanent after longstanding abstinence, or does near full recovery occur? The current study assessed working memory function and attention differences between addicts reporting long-term abstinence and individuals reporting no history of substance use. Volunteers were recruited from both Narcotics Anonymous meetings and the community; addicts reporting long-term abstinence and individuals reporting no substance abuse history. The Test of Premorbid Functioning (Advanced Clinical Solutions for the WAIS) was used to predict working memory scores. Predicted scores were then compared to actual working memory scores from the working memory subtests scores WAIS. No differences were found between groups for working memory scores. Attention was assessed using the Stroop Color and Word Test in conjunction with the Nonverbal Stroop Card

Sort Test. No differences in interference or Stroop effect were found between groups. This data suggests that some recovery of executive function may occur with prolonged abstinence from substance use. Implications for future research and clinical work are discussed.

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Chapter 1

Introduction

According to the World Health Organization (WHO; 2013), in 2002 there were an estimated 185 million illicit drug users globally, many of whom use and abuse stimulant medications. Stimulants are a class of illicit drugs that can have dramatic negative impact on individuals who use them, but this impact is often masked by the presumed benefits of stimulants. Perhaps because these drugs have the appearance of benefit, they have a history of being developed and manufactured, even by government and military organizations. In the United States, for instance, amphetamines, and all their known derivatives, have been used in the military since World War II (Bower & Phelan, 2003). Deleterious effects of stimulant use include health concerns, social chaos, and criminal activity associated with stimulant addiction.

At present, stimulant abuse is becoming a pandemic problem. The United Nations Office on Drugs and Crime estimate that nearly 500 metric tons of stimulants are produced a year, supplying nearly 24.7 million addicts (Foundation for a Drug-Free World [Foundation], 2013). Furthermore, stimulant use is not limited to any specific geographical region, bound by any borders, or specific to any ethnic group. In fact, the United States, the Czech Republic, Sweden, Finland, Slovakia, Latvia, Southeast Asia, Thailand, and the Philippines all report substantial problems within their respective populations (Foundation, 2013).

Not only is stimulant use spreading throughout the world, there is a steady increase in the prevalence of all substances when comparing younger cohorts to older cohorts cross-nationally

(Degenhardt et al., 2010). This is unfortunate because of how it may compromise normal patterns of brain development. For example, adolescents may be at risk of developing less than optimal levels of cognitive functioning when they consume alcohol in excess (Ferrett, Carey, Thomas, Tapert, & Fein, 2010).

For the purpose of this study, the following three categories of substance abuse are of particular interest:

1. Chronic use, which includes, but is not limited to, the use of a substance daily, or multiple times a day, for a period of time lasting more than a few months.
2. Methamphetamine (meth) and stimulant use, which will include all substrate forms of amphetamine, cocaine, and other stimulants that are abused.
3. Polysubstance abuse, which will include those addicts who may have a preferred drug of choice, but when or if it is not available, make use of any available substance. Often these individuals begin with more common, less harmful substances that led to the use of more detrimental substances later.

Whereas the scientific literature on chronic drug use and meth abuse is robust, there is a dearth in the literature when it comes to polysubstance abuse. Many researchers mention it, as a sort of side note, in that their findings specific to a particular substance may be lacking because there are no “purists” among substance abusers and populations of addicts that strictly adhere to use of a specific substance do not exist, at least not in a measurable magnitude. One problem associated with stimulant abuse is that it is very often used in combination with or subsequent to the use of other drugs. Despite addicts having a preferred substance and method of use, illicit drug use is associated with

tobacco, alcohol, and cannabis use, suggesting that polysubstance use is fairly common (Degenhardt et al., 2010). Moreover, polysubstance abuse has been associated with significant neuropsychological deficits, at least among males (Medina, Shear, Armstrong, & Dyer, 2004). Some research suggests that one's preferred substance has no effect on the extent of executive functioning deficits among polysubstance abusers (Verdejo-Garcia & Perez-Garcia, 2007b).

Substance Abuse and Cognitive Impairment

A wealth of research on the effects of stimulant and polysubstance abuse on cognitive functioning has associated long-term drug use with cognitive impairment though the cause-and-effect link is not clear. Some suggest that cognitive deficits may make some more vulnerable to substance abuse than others (Block, Erwin, & Ghoneim, 2002; Latvala et al., 2009) whereas others presume the substance abuse to be the source of the cognitive impairment (Fernandez-Serrano, Perez-Garcia, Prales, & Verdejo-Garcia, 2010; Fisk, Montgomery, Wareing, & Murphy, 2005; Lundqvist, 2005; Rendell, Mazur, & Henry, 2009; Robbins, Ersche, & Everitt, 2008; Verdejo-Garcia, 2011). On one hand, Block et al. (2002) investigated school records and found that poor intellectual functioning, as indicated by poorer performances on standardized test scores recorded in elementary school years, may actually be a predictor of drug abuse. On the other hand, meth and other substance abuse has been linked with impaired verbal ability, deficits in psychomotor processing (Latvala et al., 2009), reasoning deficits that may lead to problematic decision making abilities (Fisk et al., 2005), retrospective memory task impairment (Rendell et al., 2009), emotional processing (Verdejo-Garcia, 2011), and abnormalities in brain regions associated with memory and learning (Robbins et al., 2008).

To further complicate matters, the assumption that polysubstance abuse is linked to cognitive deficits is not always supported. Rapeli et al. (2005) found no differences on measures of executive functioning or attention between control and substance abuser groups. Further, even when differences exist not all cognitive domains assessed are deficient among polysubstance abusers (Latvala et al, 2009), and some evidence even suggests that under some circumstances polysubstance abusers may have higher intelligence scores than others, perhaps because they are less inhibited when completing the tests (Montgomery, Fisk, Newcombe, & Murphy, 2005). When differences exist not all individuals demonstrate the same level of deficit, suggesting that not all abusers are subject to similar deficits (Kalapatapu et al., 2011).

In contrast to variable findings of polysubstance abuse research, chronic drug use is consistently associated with poorer performances in all cognitive functioning measures (Block et al., 2002). Chronic substance abuse has also been associated with deficits in executive functions. Significant executive function impairment was found among chronic meth users in a meta-analysis (Scott et al., 2007). Additionally, groups consisting of chronic drug users were shown to have marked impairments in spatial planning, paired associate learning, and visual pattern recognitions type tasks when compared to controls (Ersche, Clark, London, Robbins, & Sahakian, 2006).

As with research on chronic drug use, research studying the cognitive effects of meth abuse reveals a clear pattern of negative consequences, especially during the periods of time when use is prominent. Current users of meth performed more poorly on measures of neurocognitive functioning than did control groups and groups of abstinent meth users (Iudicello et al., 2010). Meth also seems to have more detrimental effects than other substances. Subjects

who identified primarily as meth abusers were found to perform significantly poorer on measures of working memory and decision-making when compared to subjects who identified as primary alcohol users and control groups (Gonzalez, Bechara, & Martin, 2007). Meth users also performed significantly poorer than others on measures of learning and delayed recall (Morgan et al., 2012). Meth has also been shown to have effects on specific brain regions and the functions of those regions. For example, meth abuse has been associated with decreased plasmalemmal reuptake transporters for dopamine, suggesting that there are structural changes in some of the dopamine nerve terminals (Johanson et al., 2006). Other findings suggest that meth use causes changes in the metabolism of the thalamus, insula, and striatum (Wang et al., 2004).

Substance Abuse and Memory

Of the broad range of cognitive impairments related to substance abuse, memory deficits seem to constitute the majority of interest in the literature. Meth dependent participants produce significantly lower results than control participants on memory tasks (Ersche et al., 2006; Rapeli et al., 2005), including prospective memory (Rendell et al., 2009), episodic memory (Scott et al., 2007), and visual memory (Morgan et al., 2012). Of memory impairment related to meth addiction, working memory comprises the largest representation in the literature (e.g., Chang et al., 2002; Gonzalez et al., 2007; Iudicello et al., 2010; Simoes et al., 2007) and is the component of executive functioning with the highest amount of impairment noted (Fernandez-Serrano et al., 2010). Memory deficits are also prevalent with polysubstance abuse (Montgomery et al., 2005), including prospective memory (Weinborn, Woods, O'Toole, Kellog, & Moyle, 2011), episodic memory (Verdejo-Garcia, 2011), and working memory (Fisk et al., 2005; Verdejo-Garcia, 2011; Verdejo-Garcia & Perez-Garcia, 2007a).

Because attention and working memory interact as separate processes (Awh, Vogel, & Oh, 2006) it is no surprise that deficits in attention have also been the focus of research. In a meta-analysis Lundqvist (2005) reports a relative consensus in the literature that most forms of substance abuse cause cognitive deficits, which include problems with attention. Polysubstance dependent individuals, assessed for cognitive functioning, showed the greatest amount of impairment in shifting at moderately severe levels (Fernandez-Serrano et al., 2010). Similar samples of polysubstance abusers showed impairment on attentional inhibitions tasks at a medium effect size (Verdejo-Garcia & Perez-Garcia, 2007a). Verdejo-Garcia (2011), reports that substance abuse disorders are commonly associated with cognitive impairments, including selective attention.

Memory Recovery

To what extent can memory deficits be recovered after abstinence from substance use? Some research suggests limited brain function recovery occurs during initial periods of abstinence (Alfonso, Caracuel, Delgado-Pastor, & Verdejo-Garcia, 2011; Fein, Torres, Price, & Di Sclafani, 2006; Iudicello et al., 2010; Morgan et al., 2012; Wang et al., 2004) whereas other studies imply that, despite periods of abstinence, there is no significant amount of recovery of cognitive functioning (Block et al., 2002; Ersche et al., 2006; Medina et al., 2004; Verdejo-Garcia & Perez-Garcia, 2007a).

The case against memory recovery. In a comparison between active substance users and drug users abstaining from use, no differences were found on neurocognitive measures (Ersche et al., 2006). These findings are similar to reports from other studies suggesting that cognitive impairments persist despite periods of abstinence (Block et al., 2002; Verdejo-Garcia

& Perez-Garcia, 2007a). Additionally, no significant relationship was found between abstinence and performance in cognitive domains (Medina et al., 2004). But each of these studies has inherent limitations, including studying participants with minimal periods of abstinence—138 days (Medina et al., 2004), three months (Block et al., 2002), and five months (Verdejo-Garcia & Perez-Garcia, 2007a). Similarly, an all male sample was used (Medina et al., 2004) and a small sample size, 26 participants (Ersche et al., 2006).

When recovery is noted, it may be the product of brain plasticity, using new structures and neuronal connections to complete tasks, instead of actual function recovery (Wang et al., 2004). This could be suggestive of no, or very little, actual brain process recovery with abstinence. The decreased plasmalemmal reuptake transporters for dopamine observed among meth users persists even after long-term abstinence, suggesting that there are irreversible structural changes in some of the dopamine nerve terminals (Johanson et al., 2006). Limitations of this research are small sample sizes—5 (Wang et al., 2004) and 16 participants (Johanson et al., 2006)—along with a relatively short 9-month period of abstinence (Wang et al., 2004).

The case *for* memory recovery. Other research supports recovery of cognitive functioning with abstinence from substance use. There is an association between the time of last use and time of assessment, indicating that recovery of brain functioning may occur with long-term abstinence (Morgan et al., 2012). Global measures of cognitive performance showed improvement for a group of meth users who had achieved some abstinence (Iudicello et al., 2010). Additionally, in a treatment setting, patients treated with Mindfulness Meditation and Goal Management Training interventions showed improvement in working memory, selective attention, and executive functioning compared to patients not treated with the intervention

(Alfonso et al., 2011). This suggests that cognitive functioning can recover. Perhaps the most promising study is one showing individuals attaining long-term abstinence for an average of 6.7 years performing as well as normal controls on all cognitive domains assessed (Fein et al., 2006). One limitation of this study is that participants were primarily abstinent from alcohol dependence rather than other types of substance abuse and dependence (Fein et al., 2006).

Current Study

The current study attempts to answer the following questions:

1. Does memory function and attention recover with long-term abstinence from polysubstance abuse (i.e., is there a difference in memory function between a group of addicts with long-term abstinence from use and a group reporting no history of substance use)?
2. Is there a relationship between length of abstinence and memory function?

Overcoming previous limitations in research was done through the attainment of a group of polysubstance users who reported a period of sustained abstinence from use lasting no less than four years in length. Additionally, a group of individuals reporting no history of substance use was attained for use as a comparison group.

Chapter 2

Methods

Participants

Twenty-four volunteer participants were recruited from regional and local area Narcotics Anonymous conventions and functions and from local churches and the community. Participants were recruited only if they fit into one of two groups: those having at least four years of abstinence and those who report no history of substance use. The latter is considered the comparison group.

Measures

Demographics Questionnaire. A demographics questionnaire was designed for this study (see Appendix 1). The questionnaire was used to gather information about participants: date of recovery, length of abuse, primary substance of use, other substances used, first substance ever used, age of first use, number of times they have been to chemical dependence treatment, number of relapses, and what has been the most instrumental in their recovery.

Patient Health Questionnaire -2- The Patient Health Questionnaire (PHQ)-2 (American Psychological Association, 2014) is used as a brief self-administered tool that assesses for depression. The PHQ-2 evaluates the degree to which an individual has experienced depressed mood or symptoms within a two-week period, with the sole purpose of screening for depression. The PHQ-2 has been validated in three different studies, exhibiting broad variability in its sensitivity of depression and depressive symptoms. For the purposes of screening for

depressive disorders, a cut-off score of 3 is considered optimal (Kroenke, Spitzer, & Williams, 2003).

Test of Premorbid Functioning. The Test of Premorbid Functioning (TOPF; Wechsler, 2009) is a revision of the Wechsler Test of Adult Reading and is used to estimate an individual's premorbid cognitive and memory functioning. The TOPF is based on a reading paradigm that requires the reading and pronunciation of words that have irregular grapheme-to-phoneme translation by the examinee, with no need for comprehension or knowledge of word meanings. Raw scores are converted to standard scores according to age. The TOPF has good reliability based on internal consistency with average reliability coefficients ranging between $r = .96$ to $.99$. Additionally, there is evidence that the TOPF offers a valid measure of premorbid functioning with even greater predictive abilities when additional demographic variables are added, such as occupation, years of education, and region. Correlation coefficients between the TOPF and WAIS-IV working memory subtest scores are $r = .52$ and $.57$ for digit span and arithmetic respectively. Additionally, the TOPF has the following correlational coefficients with the WAIS-IV composite scores of Verbal Comprehension Index (VCI), Perceptual Reasoning Index (PRI), Working Memory Index (WMI), Perceptual Speed Index (PSI), General Ability Index (GAI) and Full Scale IQ (FSIQ): $r = .75, .50, .61, .70,$ and $.70$.

Wechsler Adult Intelligence Scale-Fourth Edition Working Memory Subtests. The Wechsler Adult Intelligence Scale—Fourth Edition (WAIS-IV; Wechsler, 2007) includes Digit Span and Arithmetic as working memory subtests. Digit Span is comprised of digits forward, digits backward, and digit sequencing. Digits forward involve rote learning and memory, attention, encoding, and auditory processing; digits backward involve working memory,

transformation of information, mental manipulation, and visuospatial imaging; and digit sequencing measures working memory and mental manipulation. Arithmetic involves mental manipulation, concentration, attention, short-term memory, long-term memory, numerical reasoning ability, and mental alertness.

Subtest raw scores from the working memory tasks are converted to standard scores according to age and compared to a normative sample. The WAIS-IV has exceptional internal consistency. The average reliability of the working memory subtests are $r = .93$ and $.88$ for digit span and arithmetic respectively. Working memory subtests show high correlations with other working memory subtests, both current and past versions, indicating strong validity. Digit span and arithmetic subtests have correlation coefficients of $.60$ and $.60$ respectively towards overall working memory index (WMI) scores on the WAIS-IV.

Stroop Color and Word Test: Adult Version. The Stroop Color and Word Test (SCWT) assesses the ability of an individual to sort information from their environment and make a choice of how to react to the information. It also provides a diagnosis of brain dysfunction and the evaluation of stress, personality cognition, and psychopathology. The effects of drugs on the performance of Stroop tasks has been the focus of several studies; of particular interest to this study are those that focused on the effects of stimulant drugs (Golden & Freshwater, 2002).

Nonverbal Stroop Card Sorting Test. The Nonverbal Stroop Card Sorting Test (NSCST; Koch & Roid, 2012) assesses cognitive interference through the use of a non-vocal administration technique that takes approximately 5-10 minutes and is intended for use with individuals ranging between the ages of 3 and 75. The test utilizes two sets of cards, one with

matching color bars and one with non-matching color bars, which are used to contrast the speed it takes to sort the cards into specific colored locations. The difference between the times it takes to sort each set of cards provides the degree of interference. Ratios and interference scores can be converted to standard *T* scores for comparison with norms. Additionally, the examiner is allowed to assess the extent of large differences indicative of processing deficits and cognitive interference.

Procedure

Experimental group. Participants reporting abstinence were recruited from local and regional conventions and functions of Narcotics Anonymous. Because this study aimed to determine memory function recovery with abstinence from polysubstance abuse, participants were screened for primary substance of abuse and length of use periods to determine goodness of fit for this study at the time of consent. To meet the criteria for this study, participants were included if their primary substance of use was a stimulant (i.e., cocaine, methamphetamine, etc.), they used other substances when their drug of choice was not available, and they had achieved a period of sobriety no less than four years in length. Once selected, consent was explained and obtained from participants along with demographic information. Participants were then assessed for pre-morbid functioning using the TOPF, working memory using the working memory subtests of the WAIS-IV, and attention using the SCWT and NSCST.

Comparison group. Participants were recruited from local churches, with an emphasis placed on The Church of Christ of Latter Day Saints and Seventh Day Adventists, because of lifestyle choices associated with those particular denominations. All comparison group participants were screened for goodness of fit at the time of consent, to determine if a history of

substance use was indicated. To meet the criteria of this study, participants in this group had to report no period of life with regular, every day substance use of any kind. Once selected, consent was explained and obtained from participants along with demographic information (see Appendices A and B). Participants were then assessed for pre-morbid functioning using the TOPF, working memory using the working memory subtests of the WAIS-IV, and attention using the SCWT and NSCST.

To ensure standardization, all assessments were administered according to the standardized methods in publishers' manuals and were administered by the same doctoral level graduate student, who has been trained in such procedures.

Chapter 3

Results

Participant information is reported in Table 1. Participant PHQ-2 scores all fell under the cutoff score of 3 (range 0-3, Mean = 0.58, $SD = 0.83$), suggesting a low probability that any subjects were under negative effects associated with depression.

Table 1

Participant information

	Experimental Group	Comparison Group
Participants	12	12
Sex	8 male, 4 female	6 male, 6 female
Age	42.09 (9.02)	33.72 (9.69)
Years of Education	13.92 (1.56)	17.33 (2.02)
Years of Abstinence	9.02 (4.29)	0
Years of Addiction	18.67 (9.13)	0
Primary Substance of Use	Stimulants	None
Polysubstance abuse	12	None

Note. Age, years of education, years of abstinence, and years of addiction are reported as mean (standard deviation).

Question 1. To test for the effects of long-term abstinence on working memory and attention, the group of abstinent addicts was compared to the drug-free group.

To assess working memory, the TOPF was used in conjunction with the WAIS-IV working memory subtests. The TOPF uses standard scores, in conjunction with demographic information, to predict WAIS working memory index (WMI) scores. Once the predicted memory

scores were recorded they were compared to actual memory scores, which were attained from each participant. Significant differences between predicted and actual WMI scores were determined using the Wechsler scoring software. Predicted and obtained scores for each participant, along with the determination of whether significant differences were present, can be found in Table 2. Significant differences, both in positive and negative directions, were assigned a value and a Chi Square for independence test was performed. No significant relationship between the group variable (abstinent or drug-free) and the impairment variable (current functioning in relation to predicted functioning) was observed, $X^2(1) = 0.39, p = 0.82$.

To assess attention, the NSCST Stroop effect and SCWT Interference scores were collected and compared. An independent-samples *t*-test was conducted to compare Stroop effect and Interference scores from the drug-free group and the abstinent addict group. No significant differences in Stroop effects were found between drug-free (Mean = 0.80, *SD* = 0.092) and abstinent (Mean = 0.19, *SD* = 0.21) conditions, $t(22) = 1.62, p = 0.12, d = 3.76$. No significant differences in Interference scores were found between drug-free (Mean = 55.67, *SD* = 5.07) and abstinent (Mean = 49.83, *SD* = 15.58); $t(22) = 1.23, p = 0.23, d = 0.50$.

An unintentional finding of this study is a significant difference in the times it took participants to complete the NSCST. An independent-samples *t*-test was conducted to compare mean times for both color-congruent and color-incongruent for each group. Significant differences were found between drug-free (Mean = 29.87, *SD* = 2.51) and abstinent (Mean = 32.84, *SD* = 4.79) for color-congruent conditions, $t(22) = 1.90, p = 0.07, d = -0.776$ and between drug free (Mean = 72.98, *SD* = 8.01) and abstinent (Mean = 86.93, *SD* = 14.09) for color-incongruent conditions, $t(22) = 2.98, p = 0.007, d = -1.217$.

Table 2

Working Memory and Attention Scores for Participants

Participant	TOPF score	Predicted WMI	Actual WMI	Dif	Sig	Interference T Scores	Stroop Effect	CC time	CI time
EG01	107	108	100	-8	N	64	-0.033	36.4	79.5
EG02	120	114	114	0	N	51	0.057	43.4	101.7
EG03	120	114	108	-6	N	54	0.006	33.6	76
EG04	100	100	95	-5	N	6	0.309	30.26	89.1
EG05	104	106	125	19	Y +	69	0.120	29.5	74
EG06	87	98	89	-9	N	51	0.168	29.33	76.98
EG07	101	102	100	-2	N	55	0.226	35.25	94.27
EG08	85	95	92	-3	N	49	0.419	32.62	100.67
EG09	89	98	92	-6	N	43	0.689	30.4	118
EG10	117	111	128	17	Y +	52	0.032	35.93	83.18
EG11	90	96	89	-7	N	58	-0.028	33.33	73
EG12	105	105	89	-16	Y -	46	0.313	24.08	76.73
CG01	112	107	114	7	N	51	0.231	30.4	85
CG02	98	106	108	2	N	63	0.114	34.87	83.04
CG03	120	111	111	0	N	46	0.028	30	74
CG04	111	110	92	-18	Y -	56	0.055	33.6	79.59
CG05	103	104	119	15	Y +	59	0.055	27.68	65.35
CG06	94	101	95	-6	N	61	0.071	29.31	71.05
CG07	107	110	102	-8	N	51	0.121	28.8	73.5
CG08	89	102	95	-7	N	60	-0.120	30.55	60.07
CG09	104	108	100	-8	N	55	0.115	27.12	69.29
CG10	122	119	133	14	Y +	60	0.005	30.55	69.12
CG11	94	101	102	1	N	53	0.078	25.96	64
CG12	77	90	80	-10	Y -	53	0.212	29.55	81.77

Column 1: Participants and groups—EG=experimental group, CG=comparison group; Column 2: TOPF—Test of Premorbid Functioning score; Column 3: Predicted WMI—predicted Working Memory score from TOPF; Column 4: Actual WMI—actual Working Memory Score from WAIS working memory subtests; Column 5: Difference between predicted and actual WMI scores; Column 6: Significance of difference, N=no, Y+=Yes in positive direction, Y-= Yes in negative direction; Column 7: Interference T scores—interference T score from Stroop Color and Word Test; Column 8: Stroop Effect—Stroop effect T score from NSCST; Column 9: CC time—Color congruent time T score from NSCST; Column 10: CI time—Color incongruent time T score from NSCST.

Thus, in this study working memory and attention deficits were not evident after prolonged abstinence, possibly suggesting that working memory and attention may recover with long-term abstinence from substance use. While significant differences between groups were not found for interference or Stroop effect scores, when effect size is taken into consideration, it seems appropriate to mention a small sample size and its contribution to findings. Finally, significant differences between groups for both color-congruent and color incongruent conditions on the NSCST likely suggest deficit that was not assessed correctly or some kind of compensatory skill learned through abstinence.

Question 2. To test for the effects of the length of abstinence on working memory and attention, overall length of abstinence was correlated with actual WMI scores. A Pearson product-moment correlation coefficient was computed to assess the relationship between length of abstinence and working memory. There was a positive correlation between the two variables, $r = 0.531$, $n = 12$, $p = 0.076$. Though this is not a significant correlation, possibly related to the small sample size, it is apparent though that more research is appropriate to deem whether the relationship remains with a larger sample.

Chapter 4

Discussion

Summary of Findings

The literature clearly identifies cognitive deficits as a product of substance abuse, especially among individuals reporting long-term use (Block et al., 2002; Fernandez-Serrano et al., 2010; Fisk et al., 2005; Latvala et al., 2009; Lundqvist, 2005; Rendell et al., 2009; Robbins et al., 2008; Verdejo-Garcia, 2011). However, the literature remains unclear as to whether the effects are enduring (Block et al., 2002; Ersche et al., 2006; Latvala et al., 2009; Medina et al., 2004; Montgomery et al., 2005; Rapeli et al., 2005; Verdejo-Garcia & Perez-Garcia, 2007a) or if over time with abstinence they subside (Alfonso et al., 2011; Fein et al., 2006; Iudicello et al., 2010; Morgan et al., 2012). In this study, no differences in working memory or attention could be discerned between a group of substance abusing individuals who achieved long-term abstinence from polysubstance abuse and individuals reporting no history of substance use. A positive correlation between length of abstinence and working memory was found, but the relationship did not reach statistical significance.

Implications

This has implications for future research. First, the relationship between length of abstinence and working memory may be statistically significant with a larger sample size. Second, it would be good to replicate this study with a sample other than a convenience sample. It is possible that those volunteering for this study had higher cognitive function than those who chose not to participate. Third, because null hypotheses can be rejected but never proved, it is

difficult to say with certainty that no differences existed between the abstinence and drug-free groups in this study. All that can be said is that no differences were detected. Large-scale research designs tracking memory recovery over time could help determine how confident to be in the findings of this study.

There are clinical implications as well. A relatively new line of research is looking at the relationship between executive functioning and addiction from a treatment perspective. For example, consider an individual coming to treatment after several years of use. The literature agrees that this individual likely suffers from executive functioning deficits. If the individual is not capable of paying attention to or processing information, cannot hold information in immediate awareness and transfer it from working memory to long-term memory, or readily recall information learned, that individual is very likely to make poor decisions, especially when concerned with substance use. In fact, poorer cognitive functioning has been associated with poorer treatment outcomes (Aharonovich et al., 2006; Mehmet, DeVito, Waters, & Carroll, 2013). This raises a related question: Should interventions that target working memory be included in substance abuse treatment? The answer is not clear though several studies suggest it could be helpful. Working memory training led to significant behavior change and reduced alcohol use by increasing control over automatic impulses in subjects abusing alcohol (Houben, Wiers, & Jansen, 2011). A meta-analysis evaluating many different treatment modalities concluded that interventions targeting executive function likely have utility for addiction treatment (Mehmet et al., 2013). Working memory was shown to decrease delay discounting, which is choosing immediate rewards instead of delayed rewards, in a group of stimulant users (Bickel, Yi, Landes, Hill, & Baxter, 2011). If memory training plays a useful role in substance

abuse treatment, then it might also be deemed appropriate for other mental health treatments among those who have recently abused substances. However, the present study suggests that memory may eventually recover, thereby lessening the need for memory training with providing mental health treatments for those who have been abstinent over a long period of time.

Another clinical implication is seen in the variability of scores in both groups. Both the abstinence group and the drug-free group had individuals who performed lower than predicted in working memory, and both groups included those who performed higher than predicted. This serves as a good reminder of the individual variation seen among all people, including those being seen for psychological treatments. It may be less helpful to determine if polysubstance abusers as a group perform as well as their drug-free counterparts than it is to make this determination for individual patients seeking clinical services. The TOPF can be a useful tool for these individual determinations.

Because no differences in Stroop effect or interference scores were detected between groups but significant differences in time scores were, it possibly suggests a delay in decision-making capabilities, or impulse control, that was learned at some point during the abstinent time period. Understanding the need to help newly recovered individuals achieve this stage in re-training brain processes should be paramount in the treatment setting. It also undoubtedly suggests that treatment, and particularly residential settings, need much more than the standard 28-day time period in which to help individuals learn new skills.

Limitations

There are several limitations to this study. First, there is a potential selection bias with this convenience sample. It is possible that those who volunteered for the study differed in some

substantial ways from those who chose not to volunteer. Second, because of the specificity of the groups, random assignment was not possible, making the methods of this study quasi-experimental. Third, as with much of the research cited in this study, the sample size was small. This can likely be attributed to the time it takes to administer the assessment battery used, the anonymous nature of patrons from the Narcotics Anonymous program, and difficulty finding individuals who report no history of substance use. Effect sizes for insignificant findings may be suggestive of significant findings in a larger sample size. Fourth, significant differences between group time scores on the NSCST may insinuate that working memory measures used for this study are faulty. Should that be the case, perhaps a broader memory assessment battery is needed. It becomes apparent that more research is needed to help determine what exactly causes the differences in time scores. Finally, it is impossible to determine from these findings if working memory and attention recover structurally or just functionally. The functional equivalence observed between groups could reflect actual structural recovery, or it could be a product of brain plasticity, as demonstrated by Wang et al. (2004).

Conclusion

Well-established problems with addiction and executive function were discussed. No significant differences were found between drug-free and abstinent groups for working memory or attention. An insignificant, but positively correlated, relationship was revealed between length of abstinence and working memory. Implications for clinical work include the possible inclusion of working memory interventions as a possible treatment modality, being sympathetic to the individual variability and nature of our clients, and understanding that there is a process of re-training that may take patience, understanding, and more time than we are currently allowed with

our patients. The limitations to this study present opportunities for more research to be conducted.

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neuropsychological functioning, and everyday memory lapses. *Archives of Clinical Neuropsychology*, 26, 746-755. doi: 10.1093/arclin/acr071

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Appendix A

Demographics Questionnaire

The assessor will ask each participant the following questions:

1. What is your recovery date?
2. How long were you active in addiction (consistent everyday use)?
3. What was your primary drug of use (what did you use most)?
4. Did you ever use other drugs?

If so, which one(s)?

5. What was the first drug you ever tried?
6. How old were you when your first used?
7. Have you ever gone to treatment?

If so, how many times?

8. Have you ever relapsed?

If so, how many times and for how long (each)?

9. What has been most instrumental in sustaining your recovery?

Appendix B

Research Participation Consent Form

Title: Working memory and long-term abstinence from substance use.

Conducted By: Larry Jasper, B.S. and Doctoral Student of Clinical Psychology at George Fox University, ljasper09@georgefox.edu

Purpose: The purpose of this study is to examine the effects of abstinence from substance use on attention and memory function in an attempt to add to the current knowledge about long-term effects of substance abuse on cognitive function.

Procedures: This study will utilize voluntary addicts recovering from substance abuse who will be given measures of premorbid functioning (TOPF working memory (WAIS-IV working memory subtests), and attention (Nonverbal Stroop Card Sorting Test). Participants will be compared with norms of each measure as well as other participant performances on measures.

Time: Administration of all measures should be completed within a 30 – 35 minute time period.

Risks/Benefits: There are no risks involved in the study. Findings from the study should provide evidence of the effects of abstinence from substance use on cognitive performance, specifically working memory.

Confidentiality and Privacy Protections: This consent form will be separated from the rest of the packet so that your name and responses are not linked together. The consent form will be held on file by the researchers. The responses will be transferred to a spreadsheet. No identifying information will be included in the spreadsheet. Furthermore, responses from a single participant will not be reported. Findings will only be reported in aggregate. Therefore, your participation is confidential and your responses are anonymous.

Statement of Consent:

I have read the above information and have sufficient information to make a decision about participating in this study. I consent to participate in the study.

Signature: _____ Date: _____

Signature of Person Obtaining Consent Date: _____

Appendix C Curriculum Vitae

Larry E. Jasper

Education

Doctor of Clinical Psychology	<i>Expected</i> May 2016
George Fox University, <i>Newberg, Oregon</i>	
Doctoral Dissertation: Preliminary Defense Passed February 2014 Defense Anticipated May 2015	
Graduate Department of Clinical Psychology: APA Accredited	
<i>Pre-doctoral Internship</i>	<i>August 2015</i> <i>– July 2016</i>
<i>Collaborative School Based Psychological Services</i>	
<i>George Fox University</i>	
<i>Newberg, OR</i>	
Master of Arts, Clinical Psychology	May 2013
George Fox University, <i>Newberg, Oregon</i>	
Graduate Department of Clinical Psychology: APA Accredited	
Bachelor of Science, Psychology	May 2011
<i>George Fox University, Newberg, Oregon</i>	
Associate of Arts, Oregon University Transfer Degree	June 2009
<i>Treasure Valley Community College, Ontario, Oregon</i>	

Doctoral Internship

George Fox University Collaborative School Based Psychological Services	August 2015 - Present
Title: School Based Psychologist Intern	
Treatment Setting: School based behavioral health and psychological testing	
<ul style="list-style-type: none"> ○ Provide psychological services to staff and student populations at two different school districts, comprised of five different schools. ○ Administer and interpret psychological assessments to determine special education and behavioral services for school districts. ○ Program evaluation of a school-wide life choices curriculum with opportunity for professional presentations. ○ Provide counseling and crisis management services to underserved youth. ○ Participate in trainings targeting behavioral health consultation services. ○ Multidisciplinary consultation with principals, school counselors, clinical psychologists, social workers, other interns and practicum students, and other professionals providing onsite care. 	

- Provide supervision for School Based Behavioral Health fourth year coordinator.
- Common presenting problems include substance abuse, family/relational distress, school/academic problems, depression, anxiety, autism spectrum disorder, self-esteem, impulse control, attention deficit hyperactivity, stress, and life transition adjustments.

Supervised Clinical Experience

George Fox University School Based Behavioral Health Services September 2014

Title: Fourth Year Graduate Coordinator – June 2015

Treatment Setting: School based behavioral health consortium

- Provide supervision for six practicum, clinical mentoring, program development, didactic training of assessment tools and procedures, multi-systemic coordination.
- Administer and interpret psychological assessments to determine special education services for school district.
- Consult with education professionals as an integral part of a multidisciplinary system
- Provide counseling services for regular clients of varying school age, ethnicity, socioeconomic status, and sexual/gender orientation.
- Common presenting problems include depression, anxiety, poor self-esteem, impulse control, stress, and adjustment to life transitions.
- **Supervisor:** Elizabeth Hamilton, PhD & Kristie Knows-His-Gun, PsyD

Cedar Hills Psychiatric Hospital December 2013

Title: Therapist – Present

Treatment Setting: Inpatient psychiatric hospital

- Provide group treatment and individual face time with patients of varying age, gender, sexual orientation, ethnicity, and socioeconomic status
- Conduct intake interviews, initial assessments, and treatment planning with patients
- Consult with physicians and other staff as a multi-disciplinary system team member
- Common presenting problems include depression, anxiety, adult psychosis, schizoaffective disorder, suicidal ideation, chemical dependence, PTSD, and co-occurring disorders
- **Supervisor:** Jory Smith, PsyD

Cedar Hills Psychiatric Hospital September 2013

Title: Practicum Therapist – May 2014

Treatment Setting: Inpatient psychiatric hospital

- Provide group and individual counseling with patients of varying age, gender, sexual orientation, ethnicity, and socioeconomic status
- Conduct intake interviews and treatment planning with patients
- Common presenting problems include depression, anxiety, suicidal ideation, chemical dependency, co-occurring disorders, and adult psychosis.
- **Supervisor:** John Benson, PsyD & Jason Goade, LCSW

George Fox University School Based Behavioral Health Services September 2012

Title: Practicum Therapist – June 2013

Treatment Setting: Yamhill-Carlton Intermediate School

- Provided individual face time with regular clients of varying age, gender, ethnicity, and socioeconomic status
- Administer and interpret psychological assessments to determine special education services for school district
- Consult with education professionals as an integral part of a multidisciplinary system
- Common presenting problems include depression, anxiety, adjustment to life transitions, impulse control, anger, family distress, and substance abuse
- **Supervisor:** Elizabeth Hamilton, PhD & Kristen Miller, MA

George Fox University Graduate Department of Clinical Psychology January 2012

Title: Pre-practicum Student Therapist – April 2012

Treatment Setting: University counseling

- Provided therapy for two undergraduate students
- Conducted intake interviews, developed treatment plans, wrote formal intake reports, wrote psychotherapy notes, reviewed video footage of sessions, and completed termination summaries
- **Supervisor:** Mary Peterson, PhD & Michael Vogel, MA

George Fox Behavioral Health Clinic Parent Advice Line October 2010

Title: Student Therapist – May 2011

Treatment Setting: Community mental health clinic

- Answered phone calls of parents seeking advice
- Offered help or advice about their children
- Provided services for individuals of varying ethnicity, socioeconomic status, age, and gender
- **Supervisor:** Joel Gregor, PsyD

Hazelden Springbrook January 2011

Title: Evening and weekend counselor intern – April 2011

Treatment Setting: Residential Treatment Center

- Provided individual and group therapy to patients of varying ethnicity, gender, sexual identity, and socioeconomic status
- Learning experience to gain knowledge of substance abuse treatment
- **Supervisor:** Kris Kays, PsyD & Teri Weber-Harris, LMSW

Relevant Academic Experience and University Involvement

Teaching Assistant

George Fox University Graduate Department of Clinical Psychology

- **PSYD 526 Child and Adolescent Assessment**, Summer 2013
- **PSYD 562-A Child and Adolescent Psychopathology**, Summer 2014
- **PSYD 502 Psychopathology**, Fall 2014
- **PSY 526 Child and Adolescent Assessment**, Summer 2015

Multicultural Committee Member

George Fox University Graduate Department of Clinical Psychology

- Attend monthly meetings designed to increase knowledge and awareness of multicultural issues, working with a diverse population, and other related topics

Health and Fitness: Alcohol and Substance Abuse Awareness

George Fox University, Newberg, OR

- Guest speaker at undergraduate Health and Fitness class

Teen Substance Abuse Awareness, Consequences, and Hope

Newberg Alternative High School, Newberg, OR

- Guest speaker who spoke to underserved youth about substance abuse

Gender and Sexuality Consultation Committee

George Fox University Graduate Department of Clinical Psychology

- Attend monthly meetings designed to increase knowledge and awareness of gender and sexuality issues, working with sexually diverse clients, recent literature, and other related topics

Peer Mentor

George Fox University, Newberg, OR

- Assist underclass PsyD student in transition to graduate school by providing academic and professional guidance and support

Research Experience, Presentations, and Publications

Doctoral Dissertation

- *Does substance abuse abstinence lead to recovery of memory function and attention*
 - The purpose of this study is to fill a gap in the literature concerned with long-term abstinence from substance abuse and recovery of working memory and attention
- **Preliminary Defense February 2013, Pass**
- **Expected Defense, February 2015**
- Committee Chair: Mark McMinn, PhD

Research Vertical Team

- Team composed of members from multiple cohorts meet twice monthly to discuss, collaborate, and present current research projects and dissertation

Effects of Concussion on Youth in Sports

- Pre and post season concussion and neurological assessment
- Advisor: Chris Koch, PhD

Addiction and Memory

- Everyday memory and attention survey administered to members of local recovery groups
- Advisor: Chris Koch, PhD

Freshman Engagement Survey

- Development and testing of survey instrument for freshman evaluation
- Advisor: Eric Ellis, Dean of Student Services, TVCC & Renae Weber, PhD

Symposiums

McMinn, M., Geczy-Haskins, L., **Jasper, L.**, Lowen, J., & Uhder, J. (2014). Large-scale psychotherapy data collected via smartphones and tablets. Symposium presented at the 121st annual convention of the *American Psychological Association, Division 40*, Washington, DC

Hamilton, E., Knows His Gun, K., Miller, K., Davis, S., McGurl, C., Tuning, C., Jasper, L., (2015). Interdisciplinary dissemination of evidence-based interventions within rural school districts. Symposium presented at the 122nd annual convention of the *American Psychological Association, Division 16*, Toronto, Ontario, Canada

Poster Presentations

Jasper, L., Koch, C., Lowen, J., Schlomer, J., & Kays, D. (2014). Changes in verbal memory during youth football. Poster presented at the 121st annual convention of the *American Psychological Association, Division 40*, Washington, DC

Jasper, L., Koch, C., & Koch, M.K. (2013). The impact of substance use on everyday memory and attention. Poster presented at the 120th annual convention of the *American Psychological Association, Division 28*, Honolulu, HI

Condrey, K., **Jasper, L.**, Zarb, D., & Gathercoal, K. (2014). Patient satisfaction: Does staffing matter? Poster presented at the annual *Oregon Psychological Association Conference*, Portland, OR

Jasper, L., Koch, C., & Koch, M.K. (2011). The impact of substance use on everyday memory and attention. Poster presented at the 19th Annual *Object Perception, Attention, and Memory Conference*, Seattle, WA

Memberships and Honors

Memberships

- American Psychological Association, Student Affiliate
- Division 50, Society of Addiction Psychology, Student Affiliate
- Psi Chi Honor Society
- Phi Theta Kappa Honor Society
- Phi Theta Kappa Alumni Association

Honors

- Summa cum Laude, *George Fox University*
- Deans List, *George Fox University*
- Deans List, *Treasure Valley Community College*

- Psychology Majors Outstanding Senior of the Year, *George Fox University*
- Phi Theta Kappa Rocky Mountain Cascade Region Distinguished Chapter Member, *Treasure Valley Community College*

Relevant Leadership Roles

- Regional Committee Member** January 2014
Yamhill Unified Area of Narcotics Anonymous -September 2014
- Attend quarterly regional service committee meeting, relay area level business to regional delegates, and communicate regional business to local area committee
- Alternate Regional Committee Member** June 2012
Yamhill Unified Area of Narcotics Anonymous -January 2014
- Attend quarterly regional service committee meeting as an alternate committee member, relay area level business to regional delegates, and communicate regional business to local area committee
- Phi Theta Kappa Alumni Association Vice President** May 2010
Rocky Mountain Cascade Region – June 2012
- Attend alumni association meetings
 - Program development, membership drives, constitution development
- George Fox University Undergraduate Psychology Club President** May 2010
George Fox University – June 2011
- Attend club meetings, advocate with student body delegates, coordinate events

Professional Training and Education

Let's Talk About Sex: Sex and Sexuality with Clinical Applications

- *George Fox University*, October 2015
- Joy Mauldin, PsyD

Relational Psychoanalysis and Christian Faith: A Heuristic Dialogue

- *George Fox University*, September 2015
- Marie Hoffman, PhD

Spiritual Formation and Psychotherapy

- *George Fox University*, March 2015
- Barrett McRay, PsyD

Credentialing, Banking, the Internship Crisis, and other Challenges for Graduate Students in Psychology

- *George Fox University*, February, 2015
- Morgan Sammons, PhD

Face Time in an Age of Technological Attachment

- *George Fox University*, November 2014
- Dorren Dodgen-McGee, PsyD

Understanding and Treating ADHD in Children/Learning Disabilities DSM5—A New Approach

- *George Fox University*, October 2014
- Erika Dtoy, PsyD, Tabitha Becker, PsyD

Evidence Based Treatments for PTSD in Veteran Populations: Clinical and Integrative Perspectives

- *George Fox University*, March 2014
- David Beil-Adaskin, PsyD

Substance use and mental disorders: Early detection, prevention, and treatment

- *Healthy People 2020 Web Seminar*, February 2014
- Howard Koh, MD, Rebecca Hines, MHS, Philip Wang, MD, Jack Stein, PhD, Frances Harding

DSM V

- *George Fox University*, January 2014
- Jeri Turgesen, PsyD

Primary Care Behavioral Health

- *George Fox University*, September 2013
- Brian Sandoval, PsyD & Juliette Cutts, PsyD

The Person of the Therapist: How Spiritual Practice Weaves with Therapeutic Encounter

- *George Fox University*, March 2013
- Brooke Kuhnhausen, PhD

African American History, Culture, and Addictions & Mental Health Treatment

- *George Fox University*, January 2013
- Danette Haynes, LCSW & Marcus Sharpe, PsyD

Sexual Identity

- *George Fox University*, November 2012
- Erica Tan, PsyD

Treating Gender Variant Clients: Christian Integration

- *George Fox University*, October 2012
- Erica Tan, PsyD

Strengthening Your Internship Applications

- *George Fox University*, March 2012
- Elizabeth Goy, PhD & David Indest, PsyD

Mindfulness and Christian Integration

- *George Fox University*, March 2012
- Erica Tan, PsyD

Cross-Cultural Psychological Assessment

- *George Fox University*, November 2011
- Tedd Judd, PhD

Lesbian, Gay, Bisexual, and Transsexual Sensitivity

- *Hazelden Springbrook*, February 2011