Evaluating the Impact of Alcohol Abstinence on the Cognitive Functioning of Adults Diagnosed with Alcohol Use Disorder

by

Erengai Elaine Mofokeng

Submitted in fulfilment of the requirements for the degree of

Master of Arts (Psychology)

in the

Department of Psychology, Faculty of Humanities. University of Pretoria

Supervisor: SN Mostert

May 2021

Declaration

I, Erengai Elaine Mofokeng (19297204), declare that this dissertation with the title *Evaluating the impact of alcohol abstinence on the cognitive functioning of adults diagnosed with alcohol use disorder*, which I submit to the University of Pretoria for examination is my own personal effort. I declare that this assignment is my own original work.

Where someone else's work was used (printed, internet and other sources) acknowledgment is given and reference is made according to departmental requirements. I took reasonable care to ensure that the work is original and to the best of my knowledge do not breach copyright law.

Erengai Elaine Mofokeng

_____ 15 May 2021

Signature **Date**

Abstract

People diagnosed with alcohol use disorder (AUD) drink to a point where their lives and those closest to them are impacted negatively. Research supports the relationship between chronic alcohol use and progressive cognitive impairment in patients diagnosed with AUD. The severity of cognitive impairments resulting from AUD varies with age, period of alcohol use, and frequency of consumption. Interventions in alcohol rehabilitation facilities mainly focus on psychosocial factors with a limited focus on cognitive functioning impairment and recovery. The main focus of the present study was to determine the extent to which the cognitive abilities of patients improve after a period of abstinence, specifically their visuospatial attention, working memory, and abstract reasoning abilities. A single group pretest-posttest design was used to assess patients diagnosed with AUD. The assessment was done on two different occasions using the WAIS-IV^{SA} battery. This allowed the researcher to identify and highlight any differences in the results obtained at Phase 1 (3-4 days after admission) and Phase 2 (14 days after Phase 1). The findings from the paired sample *t*-test revealed that there was no significant difference in assessment scores for abstract reasoning and working memory. A statistically significant increase was found in AUD patients' visuospatial scores when comparing Phase 1 and 2 (M = 7.11, SD = 2.07), $t(8) = 3.42$, $p = .009$.

Keywords**:** Abstract reasoning, alcohol abstinence, alcohol use disorder, cognitive impairment, visuospatial attention, working memory

List of Abbreviations

AUD	Alcohol Use Disorder
VA	Visuospatial Attention
AR	Abstract Reasoning
WM	Working Memory
GABA	Gamma-Aminobutyric Acid
fMRI	functional magnetic resonance imaging
CBT	Cognitive behavioural theory
SEM	Standard error of the mean

Acknowledgments

Supervisor:	SN Mostert
Department:	Psychology
University:	University of Pretoria
Degree:	Master of Arts (Psychology)

I would like to acknowledge the following people for their contribution to this research project:

- Jesus, for the talent and passion for Academia.
- My family, for the financial support and never allowing me to quit.
- Ms Sonja Mostert, for your expertise, supervision, and academic guidance.
- JvR Psychometrics, for the sponsorship.
- The local treatment entre for allowing me access to their facilities and most importantly to the patients for their consent.
- Mr A Wutawunashe, for your academic support.
- Mr I Mutsungi, for your assistance with the statistical section of the research.
- Ms N Gama, for your professional conduct with administering the assessments.

TABLE OF CONTENTS

Declaration **i**

Abstract **ii**

List of Abbreviations **iii**

Acknowledgments **iv**

CHAPTER 1 Introduction 1

1.1 Background 1

1.2 Problem Statement 3

1.2.1 Research Questions 4

1.2.2 Null and Alternative Hypotheses 4

1.3 Aims and Objectives of the Study 4

1.3.1 Justification of the study 5

1.4 Structure of the Study 6

CHAPTER 2 Literature Review 7

2.1 Alcohol Use Disorder 7

2.2 Alcohol and the Brain 9

2.3 The Addiction Process 10

2.4 Abstract Reasoning 12

2.5 Visuospatial Attention 13

2.6 Working Memory 15

2.7 Abstinence and Recovery 17

2.8 Conclusion 19

CHAPTER 3 Theoretical Framework and Methodology 20

3.1 Theoretical Framework 20

3.1.1 The Social Learning Theory 20

3.1.2 The Personality Theory 21

3.1.3 The Behavioural Theory 23
3.1.4 The Cognitive Behavioural Theory 24
3.1.5 Motivation for selected theoretical framework 26
3.2 Methodology 27
3.2.1 Research Design and Methodology 27
3.2.2 Sampling 29
3.2.2.1 Sampling method 29
3.2.2.2 Selection criteria 30
3.2.2.3 Sample size 30
3.2.3 Treatment Centre 30
3.2.4 Data collection instruments 32
3.2.5 Data collection procedure 35
3.2.6 Data analysis techniques 35
3.2.7 Quality criteria of the study 36
3.3 Ethical Considerations 37
3.4 Conclusion 38
CHAPTER 4 Research Results and Data Analysis 40
4.1 Research Results 40
4.1.1 Socio-demographic variables of the patients 40
4.2 Patient (Phase 1) Scores and Completion Times 41
4.2.1 VA Scores and Completion Times 41
4.2.2 AR Scores and Completion Times 42
4.2.3 WM Scores and Completion Times 44
4.3 Patient (Phase 2) Scores and Completion Times 45
4.3.1 VA Scores and Completion Times 45
4.3.2 AR Scores and Completion Times 47

4.3.3 WM Scores and Completion Times 48
4.4 Comparison of Phase 1 and 2 Patient Scores and Completion Times 49
4.5 Paired Sample *t*-test Results per Cognitive Function for Patient Group Scores (Phase 1 and 2) 52
4.5.1 Paired sample t-test for VA 53
4.5.2 Paired sample t-test for AR 53
4.5.3 Paired sample t-test for WM 53
4.6 Conclusion 54
CHAPTER 5 Discussion and Limitations 55
5.1 Interpretation of the Findings in Relation to Specific Cognitive Functions 55
5.1.1 Visuospatial Attention 55
H1: Alcohol abstinence improves the visuospatial attention ability of AUD patients. 56
5.1.2 Abstract Reasoning 57
H2: Alcohol abstinence improves the abstract reasoning ability of AUD patients. 58
5.1.3 Working Memory Discussion 59
H3: Alcohol abstinence improves the working memory ability of AUD patients. 59
H0: There is no statistically significant improvement in the cognitive functioning, specifically visuospatial attention, abstract reasoning, and working memory of AUD patients following abstinence. 59
5.2 Limitations 60
CHAPTER 6 Conclusion and Recommendations 63
References 65
Appendices 81
Appendix 1: Demographic Questionnaire 81
Appendix 2: Participant Information Sheet 83
Appendix 3: Participant Consent Form 85

Appendix 4: Centre Consent Document 87

Appendix 5: Summary of WAIS-IV^{SA} 88

Appendix 6: Proof of Editing 89

LIST OF FIGURES

Figure 1: *VA Comparison of Phase 1 and 2 Scores* 49

Figure 2: *VA Comparison of Phase 1 and 2 Completion Times* 50

Figure 3: *AR Comparison of Phase 1 and 2 Scores* 50

Figure 4: *AR Comparison of Phase 1 and 2 Completion Times* 51

Figure 5: *WM Comparison of Phase 1 and 2 Scores* 51

Figure 6: *WM Comparison of Phase 1 and 2 Completion Times* 52

LIST OF TABLES

Table 1: *Theoretical Models Focusing on Causal Effects of Personality on Alcohol (Littlefield & Sher, 2010)* 22

Table 2: *Summary Scope of Treatment for AUD* 32

Table 3: *Reliability of the WAIS-IV Subtest, Indexes and FSIQ in the SA Validation Sample (Adapted)* 34

Table 4: *Socio-demographic Details of Patients* 40

Table 5: *VA Total Raw Scores (Phase 1)* 41

Table 6: *VA Completion Times (Phase 1)* 42

Table 7: *AR Total Raw Scores (Phase 1)* 43

Table 8: *AR Completion Times (Phase 1)* 43

Table 9: *WM Total Raw Scores (Phase 1)* 44

Table 10: *WM Completion Times (Phase 1)* 45

Table 11: *VA Total Raw Scores (Phase 2)* 45

Table 12: *VA Completion Times (Phase 2)* 46

Table 13: *AR Total Raw Scores (Phase 2)* 47

Table 14: *AR Completion Times (Phase 2)* 47

Table 15: *WM Total Raw Scores (Phase 2)* 48

Table 16: *WM Completion Times (Phase 2)* 49

CHAPTER 1 Introduction

This chapter provides a background of the study and offers clarity on the problem under investigation. The focus of the study was to investigate the impact of abstinence on the cognitive functioning of people diagnosed with AUD. The first part of this chapter details the research problem and questions, followed by the aim and objectives of the study. The justification of the study is also outlined. The chapter concludes with details about the structure of the dissertation.

1.1 Background

Alcohol consumption is a social pleasure for most people; however, for some, the ability to control their consumption is difficult, crossing the boundary between social drinking and addiction (Enoch, 2008). Alcoholism is recognised as a chronic progressive disease by both the World Health Organization and several medical aids: by the time a person is diagnosed with AUD, they would have started with minimal volumes of alcohol use and frequency of alcohol consumption (Crossroads Recovery Centres, 2016). Research supports the relationship between chronic alcohol use and progressive cognitive impairment (Banerjee, 2014; Bates, Buckman, & Nguyen, 2013; Bernadin, Maheut-Bosser, & Paille, 2014; Erdozain et al, 2014). The severity of cognitive impairments resulting from AUD varies, and age, period of alcohol use and frequency of consumption must be considered (Batman, 2015).

Research indicates that various social, physical, psychological, and occupational consequences, regarding alcohol-related cognitive impairments are often overlooked during treatment. The main focus of treatment is generally on social and psychological factors related to alcohol abuse, and treatments are more aligned with addressing these problems. This poses a challenge when designing cognitive rehabilitation interventions to treat AUD (Bates, Buckman, & Nguyen, 2013). As a result, the cognitive decline associated with alcohol abuse is often neglected. One of the main focus areas of treatments with AUD patients is based on

abstaining from alcohol use. In addition to discontinuing the use of alcohol, treatment programmes also include a psychological and social component to help the patient deal with their alcohol-related problems. The current study intended to emphasise the impact and consequences of alcohol abuse on the cognitive-functioning of AUD adults. The researcher intended to assess the cognitive functioning of AUD patients, specifically abstract reasoning, working memory and visuospatial reasoning, at intake, to determine a baseline measure of their cognitive functioning. After a period of abstaining from alcohol use, as part of the treatment, a post-test measure of patients' cognitive functioning was obtained. The main motivation of the present study was specifically on determining the extent to which the cognitive abilities of patients may improve after a period of abstinence.

Researchers in the field of alcohol addiction reported that recovery from alcohol dependence includes different brain functions and behavioural changes associated with different stages of abstinence (Cui et al., 2015). A study by Demirakca et al. (2011), for example, investigated the impact of abstinence on global grey matter (GM) and white matter changes as well as regional and local GM changes. The results showed significant gains in regional volumes in the group of abstinent patients, whereas no volume change was found in the patients who had relapsed (Demirakca et al., 2011). Another study by van Eijk et al. (2013), was conducted on volumetric amelioration and the results indicated recovery of volumetric amelioration within a few days after detoxification with variances between brain regions (van Eijk et al., 2013).

Recovery is possible in various stages of abstinence but interventions for the rehabilitation of alcohol dependence cannot be one dimensional but need to incorporate various disciplines. Approaches dealing with psycho-affective, behavioural, and cognitive consequences seem to be the most effective due to the neuropsychological alterations experienced by alcohol-dependent people (Siccardi et al., 2014). Clinical practice, however, seems to underestimate

alcohol-related cognitive impairments, even though these impairments could limit the benefits of alcohol treatment and hamper the patient's ability to remain abstinent (Cabe et al., 2016). To emphasise the consequences of alcohol abuse on cognitive functioning, the researcher endeavoured to assess the impact of alcohol abstinence, as part of a treatment programme, on specific cognitive functions in a group of AUD patients.

1.2 Problem Statement

Research supports a relationship between chronic alcohol use and progressive cognitive functional impairment (Erdozain et al., 2014). Recovery occurs to impaired brain regions with prolonged abstinence, but different stages are linked to different degrees of recovery (Loeber et al., 2010). Research shows that cognitive abilities can improve, but the extent and rate at which this takes place is often overlooked and is still debated (Cui et al., 2015). Exploring the progressive transformation of cognitive abilities to assess the impact of abstinence may thus be valuable.

Rehabilitation centres often neglect to incorporate comprehensive psychological assessments related to cognitive recovery, partly due to the scarcity of literature about the impact of AUD on cognitive functioning. The time-consuming nature and costs of the research process as well as the stronger emphasis on social and psychological factors also play a contributing role (Jurado-Barba et al., 2017). The researcher intended to evaluate the impact of alcohol abstinence on the cognitive functioning of adults diagnosed with AUD over an extended period using an assessment designed to measure various types of cognitive abilities.

1.2.1 Research Questions

The present research constructed the main research question to unravel the relationship between abstinence and cognitive impairment. The research question that guided the study was:

To what extent do the working memory abilities, abstract reasoning and visuospatial attention skills of adults diagnosed with AUD improve after alcohol abstinence?

1.2.2 Null and Alternative Hypotheses

The null and alternative hypotheses are as follows:

H1: Alcohol abstinence improves the visuospatial attention ability of AUD patients.

H0: There is no statistically significant improvement in the visuospatial attention of AUD patients following abstinence.

H2: Alcohol abstinence improves the abstract reasoning ability of AUD patients.

H0: There is no statistically significant improvement in the abstract reasoning of AUD patients following abstinence.

H3: Alcohol abstinence improves the working memory ability of AUD patients.

H0: There is no statistically significant improvement in the working memory of AUD patients following abstinence.

1.3 Aims and Objectives of the Study

The purpose of the study was to emphasise the consequences of alcohol abuse on the cognitive functioning of AUD patients and how abstaining from alcohol may contribute to improving cognition. The aim of the research was to evaluate the impact of alcohol abstinence on cognitive functioning; specifically, visuospatial attention, working memory and abstract reasoning on two different occasions using the WAIS-IV^{SA} battery. This allowed the researcher

to identify and highlight any differences in cognitive functioning at Phase 1 (3-4 days after admission) and Phase 2 (14 days after Phase 1). In line with the research questions, the objectives of the research are stated as follows:

1. To assess the extent to which working memory ability in AUD patients is improved by abstinence.
2. To assess the extent to which visuospatial attention in AUD patients is improved by abstinence.
3. To assess the extent to which abstract reasoning in AUD patients is improved by abstinence.

1.3.1 Justification of the study

In evaluating the impact of abstinence on AUD patients, this study seeks to benefit the cognitive psychology discipline by adding to the literature on AUD and offering opportunities for further research in the efficacious remedies of AUD. The study intended to emphasise the notion that serious cognitive impairments may result from alcohol abuse (Bernadin et al., 2014) by demonstrating the pre-and-post level cognitive functioning of patients before and after a period of abstinence.

The purpose was primarily to emphasise the consequences of alcohol abuse on cognitive functioning and to explore the difference abstinence can make in this regard. The findings can be used to guide the development of treatment programmes to include a cognitive assessment and intervention component, apart from the exclusive focus on the social and psychological domains. Information gathered from the research may also benefit public and private agencies that need to disseminate literature related to planning and implementing practices for prevention and therapy of AUD patients.

The sparsity of literature on AUD also justifies the need for more research on the cognitive functioning of long-term alcohol use. The findings from the study can provide helpful information to alcohol rehabilitation centres on the value of incorporating cognitive functioning recovery interventions as part of AUD treatment. The findings may also emphasise the importance of taking a multidimensional approach in treating AUD (Fein et al., 1990).

1.4 Structure of the Study

The dissertation is structured as follows:

- **Chapter 2 Literature Review;** entails the review of literature relating to AUD and the implications of impairment on the brain and related therapies.
- **Chapter 3 Theoretical Framework & Methodology;** covers the research design and methodology, as well as the underlying paradigm and theoretical framework relating to the study.
- **Chapter 4 Research Results and Data Analysis;** describes the results in each Phase of the assessment including the analysis of the collected data.
- **Chapter 5 Discussion and Limitations;** provides assessment comprehensive discussion of the obtained results, their implication and general contribution to the discipline as well as alignment with relevant literature. It also states any limitations, constraints or any elements in the study that may preclude holistic generalisation of results as well as assessing the general probity of the study.
- **Chapter 6 Conclusion and Recommendations;** provides conclusions drawn from the obtained results and presents recommendations for future studies.

CHAPTER 2 Literature Review

This chapter provides an overview of literature in the field of AUD and abstinence. A summary of the process of addiction and alcohol-related cognitive impairment is also be provided.

2.1 Alcohol Use Disorder

Chronic alcohol consumption of excessive quantities has been linked to various neurophysiological and cognitive alterations such as the ability to learn, memory deficits, an impairment in decision-making and challenges with motor skills. Patients may also present with psychological symptoms including anxiety and depression (Erdozain et al., 2014; Woods et al., 2016). In the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), issued by the American Psychiatric Association, the abuse of alcohol and dependence are combined into a single disorder known as AUD with sub-classifications of mild, moderate, and severe. The severity is based on the number of criteria met (NIAAA, 2016). The DSM-5 also describes AUD as being characterised by a desire that is persistent or by efforts that are unsuccessful to limit or control the use of alcohol; the person consuming the alcohol does so despite the negative physical, psychological, occupational, or social consequences experienced.

Other characteristics of alcohol dependence include lacking control over extreme consumption of alcohol regardless of the significant negative consequences. Studies relate the impulsive and compulsive behaviour to functional abnormalities within networks of brain regions responsible for controlling decision-making (Fein & Cardenas, 2015). Alcohol abuse involves excessive alcohol use and spans across different cultures and impacts people in different races, gender, and age groups. People with AUD struggle to stop drinking once they have started (Nathan et al., 2018). Negative consequences that result from alcohol use seem to stem from impairments in brain functioning, specifically those related to working memory, a

person's motivation and attention, their performance monitoring, and ability to learn and make decisions (Wilcox, Dekonenko, Mayer, Bogenschutz, Turner, 2014). According to a study by Fein and Cardenas (2015), pursuing damaging behaviours such as intoxication and losing one's inhibitions may be because of the inability to link consequences to the displayed behaviours. The study, from a neurobiological perspective, further mentioned that this identified pattern implies that there is a strong impulsive and compulsive urge to consume alcohol which contributes to poor decision-making and behaviours that are risky in people diagnosed with AUD (Fein & Cardenas, 2015). Research shows that AUD is more than just a lack of self-control but more related to deficits in cognitive control. The control of cognition involves the use of executive functions, such as attention, planning, or working memory, to guide appropriate behaviours to achieve a specific goal (Breukelaar et al., 2017). This cognitive control is also implicated in the development of AUD (Molnar et al., 2018). A study by Wilcox et al. (2014), discussed cognitive control processes related to AUD. They defined cognitive control as "internal representation, maintenance and updating of context information in the service of exerting control over thoughts and behaviour" (Wilcox et al., 2014, p. 8).

If cognitive control in AUD is altered, individuals with AUD might experience problems with maintaining abstinence. Wilcox et al. (2014) argued that cognitive recovery is likely to improve with abstinence, but the authors reasoned that there is a need for further research to clarify the specific aspects of cognitive control that are most important for sufficient treatment of AUD. A study used fMRI to investigate the behavioural and brain activity of cognitive control in heavy and light episodic drinkers during response-conflict induced by the Stroop task (Molnar et al., 2018). The results from the study indicated that although the heavy episodic drinkers could complete the task, they rated the task as being significantly more difficult and demonstrated longer response times than the light episodic drinkers (Molnar et al., 2018). These results correlate with a study by Bagga et al., (2014), which also indicated that AUD patients can

complete administered assessments or tasks but with increased cognitive demands. The results from these studies highlight the important consequences of alcohol abuse on cognition and also informed the researcher's hypothesis that abstinence does impact recovery, however the extent of the impact is yet to be established. The long-term consequences of alcohol abuse also demonstrate significant neurological impacts (Woods et al., 2016).

2.2 Alcohol and the Brain

The review of literature from the early 1970s indicates minimal focus on the relationship between alcohol and neurobiology, mainly due to the lack of research focused on neurobiology in general (Zahr et al., 2010). At the time, the theory was that the key breakdown product of alcohol, acetaldehyde, instead of ethanol, may have a direct role in brain changes through chronic alcohol consumption (Sullivan et al., 2010). Over the years, research has indicated the role that ethanol played in the inhibition and release of other neurotransmitters. Alcohol prohibits the communication of one neuron to another which leads to some common symptoms of intoxication including lack of inhibition, slurred speech, poor memory and slowed reflexes (Brust, 2010). Various neurotransmitters, especially at the Gamma-Aminobutyric Acid (GABA) and Glutamate synapses, have been associated with alcohol addiction. Based on their role in the brain, alcohol may cause imbalances related to either excess or inhibition activity with these neurotransmitters (Banerjee, 2014).

As an individual increases their frequency and dosages of alcohol consumption, the GABA receptors become less responsive and higher alcohol concentrations are required so that the same levels of suppression can be achieved – this is called "tolerance" (Kanchan et al., 2016). Chronic alcohol consumption causes well-recognised neurophysiological and cognitive alterations (Woods et al., 2016). Neuro-imaging has revealed the prevalent effects of alcohol and how the brain acts on various target cells within cell membranes by inducing effects on

neurotransmitter receptors (Enoch, 2008). Through the use of neuro-imaging combined with various psychological evaluations of various brain functions, studies on alcoholism indicated evidence that chronic alcohol consumption leads to the degeneration of various brain functions (Armstrong & Barker, 2001; Bernadin, Maheut-Bosser, & Paille, 2014; Cabe et al., 2016; Erdozain et al., 2014; Przedborski, Vila, & Jackson-Lewis, 2003; Zahr, Pitel, Chanraud, & Sullivan, 2010).

Over the years, research has focused on the importance of the neurotransmitter dopamine and the role it plays in the addiction of alcohol. The focus was largely influenced by the discovery of how acute alcohol exposure activates dopaminergic reward pathways (Koob & Volkow, 2010), impacting the positive reinforcement and reward system of the brain (Diana, 2011). Dopamine has also been noted as a key contributor to the process of addiction, however since its side-effects are minimal, there is limited use of identified medication that works directly on the dopaminergic system (Dopamine and Alcohol Dependence: From Bench to Clinic, 2016). Significant advances have been made in enriching our understanding of alcoholism from a neuroscience perspective. Further research is, however, still required to allow for discoveries leading to insight in understanding neural degradation with chronic alcoholism and repair leading to sustained abstinence. These discoveries will also assist in the design of more effective interventions to treat AUD.

2.3 The Addiction Process

An addiction to a substance is a chronically relapsing disorder characterised by (a) a compulsion to seek and take the substance, (b) a loss of control in limiting intake, and (c) the development of negative emotional states (dysphoria, anxiety, irritability) when access to the substance is prevented (Koob & Volkow, 2010). The aetiology and pathology of alcohol dependence involve a combination of biological, psychological, and socio-environmental

factors with research demonstrating a strong relationship between alcohol consumption and the brain's reward system (Mha & Zhu, 2014). The reward system regulates physiological functions related to survival such as eating, water intake, and sexual behaviour. It is also the target of psychoactive substances including alcohol, cocaine, amphetamine, and opioids (Brust, 2010). Alcohol dependence influences the initiation of addictive processes through functional alterations of parts of the brain's reward system, known as the dopaminergic system (Mha & Zhu, 2014). One of the addictive behaviours experienced by alcohol-dependent individuals is caused by the conflict between an urge to drink and the desire to limit alcohol intake (Bernadin et al., 2014). This conflict of "urge and desire" can be explained because drinking behaviour involves two cognitive systems known as impulsive and reflective (Wiers et al., 2010). Krishma and Strack (2017), described the reflective-impulse model as; (a) operationally conscious, (b) flexible, (c) requires motivation, and (d) operates according to propositional principles. The impulsive system is always active, inflexible, and operates unconsciously according to associative principles.

Bernadin, Maheut-Bosser, and Paille (2014) conducted a study which showed that the interaction of the systems is based on the theory that the impulsive system activates drinking behaviour except when the subject can maintain control by using the reflective system. Their study suggested that the impulsive system perpetuates the addictive behaviour, which leads to the continued deterioration of the reflective system. They concluded by deducing that impairment to the reflective system observed in alcohol-dependent patients predisposes them to drinking behaviour.

Factors such as gender, age, genetic disposition, comorbid psychiatric and substance use disorders all influence a person's risk for alcoholism (Gilbertson, Prather, Nixon, 2008). These factors, together with AUD influence neurocognitive functioning following detoxification (Gilbertson et al., 2008). Based on the neurobiological implications of alcohol abuse and the

nature of addiction, several studies support the impact of alcohol use on cognition (Cabe et al., 2016; Topiwala et al., 2017). Analysing assessment scores in studies regarding AUD is one of the methods used to evaluate the impact of alcohol abuse on cognition (Brennan et al., 2020). The selected cognitive domains in this study were those that could be measured with research-based evidence of being impacted by AUD. Research indicates that chronic alcohol abuse is closely related to the impairment of cognitive abilities; with the impairment being most evident in higher order cognitive functions, such as AR, visuospatial processing and problem-solving (Bagga et al., 2014). While there are limitations on the specific details of how alcohol abuse impacts cognitive functioning, research has indicated that the impact is detrimental with effects ranging from memory impairment (encoding and retrieval), executive function, and overall cognition (Devere, 2016).

The researcher acknowledges that various cognitive domains are influenced by alcohol consumption, but given the prominent influence on working memory, perceptual-motor integration, abstract reasoning, new learning and attention (Erdozain et al., 2014; Montgomery et al., 2012; Velayudhan & Saraswathy, 2020), the researcher focused exclusively on the following: abstract reasoning, visuospatial attention, and working memory.

2.4 Abstract Reasoning

Abstract Reasoning (AR) is but one of various cognitive domains impaired by alcoholism and refers to the ability to quickly identify patterns, logical rules and trends in new data followed by integration and application of this information to solve problems (Astorga, 2013). Another view on AR is that it involves problem-solving and reasoning for problems to which there are no familiar solutions (Shakeel & Goghari , 2017). AR also requires the ability to visualise relations among objects or events, form hypothetical mental models to mentally manipulate these relations by applying inferential deductions (Datta & Roy, 2015).

An inability to understand the consequences of actions, difficulty with the interpreting verbal information, and failure to understand relationships between events and being unable to generalise learning to new situations are characteristics of AR deficits associated with neuropsychological dysfunction in children diagnosed with Foetal Alcohol Spectrum Disorders (FASD), (Zieff et al., 2016). In a study conducted by Bagga et al., (2014), an AR task-based functional magnetic resonance imaging (fMRI) was conducted on alcohol-dependent subjects (n=16) and healthy controls (n=18) to observe patterns present in neural activation.

The study contributed to the current understanding of the neuropsychological basis of poor abstract reasoning abilities in alcohol-dependent subjects. The findings from the behavioural data indicated that alcohol-dependent participants used additional brain areas to execute behavioural demands for the same task performance compared to controls (Bagga et al., 2014). There was, however, no significant difference in their response accuracy. This suggests that although alcohol-dependent participants could complete the tasks, it took more effort for them and required using additional brain areas. These findings provide additional support for the importance of AR abilities and why further research into how AR is influenced by alcohol abuse and abstinence is needed.

2.5 Visuospatial Attention

Visuospatial attention is an adaptive mechanism in a complex multisensory world allowing a person to pursue specific goals while being able to respond to and process stimuli in the surrounding environment (Doruk et al., 2018). Visuospatial attention involves the selection of information in relation to where stimuli are in space (Zirnsak & Moore, 2015). According to research, prolonged use of alcohol is responsible for the impairment of performance in tasks that require attention, with evidence supporting that chronic alcohol use does not

homogeneously impair all brain regions involved in selective attention (do Canto-Pereira et al., 2007).

There are two distinguishable frames of reference in visuospatial attention: egocentric or allocentric. The egocentric visuospatial representation is significant in the role of movement planning and motor controls when there is direct interaction between body and objects; the allocentric representation is significant when a person is determining spatial references within their environment (Ickx et al., 2017). According to Mocaiber et al., (2011), alcohol's effects on behaviour can be interpreted according to the Alcohol Myopia Theory. This theory is based on the concept that humans are constantly under the influence of internal or external stimuli which affect behaviour. In situations of alcohol intoxication, cognitive capacity is restricted, and attentional resources are preferentially allocated to more relevant or immediate stimuli. This suggests that a person's sense of judgement may be negatively impacted since the focus is more directed at immediate and explicit information without considering the outcomes or consequences (Mocaiber et al., 2011).

A study by do Canto-Pereira et al., (2007), examined how acute alcohol intoxication affects the spatial distribution of visual attention in alcohol groups and controls. The participants were assessed in two experiments. In the first experiment they were requested to direct their visual attention to the centre and in the second they had to direct their attention covertly to the right and the left, but not to the centre.

Results indicated a fixed attention to the centre, with no evidence of the ability to disengage their attention from that centre, from the participants in the alcohol group as compared to the controls. The study concluded by stating that while acute alcohol intoxication may not homogeneously impair all brain regions involved in selective attention, it impairs the ability to dissociate attention from gaze (do Canto-Pereira et al., 2007).

Conclusions from this study are consistent with the Alcohol Myopia Theory and correlate with conclusions from a study by Harvey, Bayless and Hyams, (2018), which affirms that alcohol intoxication depletes attentional resources (Harvey et al., 2018). A study by Zehra et al., (2019), investigated the neural responses of 19 recently abstinent patients diagnosed with AUD and 23 healthy controls on a visual attention task using fMRI. While there were no behavioural differences (accuracy or reaction time) between the groups, the results indicated decreased visual attention activation in the brain regions being investigated compared to controls.

Due to the neural basis of attention deficits in people with AUD remaining relatively unexplored, the impact of prolonged abstinence on visuospatial attention remains unknown.

2.6 Working Memory

Working memory (WM) is defined as “the brain’s ability to retain a limited amount of information in a readily accessible form and it facilitates planning, comprehension, reasoning, and problem-solving” (Cowan, 2014, p. 221). There is agreement amongst researchers that working memory plays a major role in goal-directed behaviours, which require the retention and manipulation of information to ensure that tasks are executed successfully (Chai et al., 2018).

An explorative study by Lechner et al., (2015), assessed the relationship between drinking behaviour, alcohol-related consequences, and alcohol-induced changes in working memory. During the research, participants were required to take part in three sessions. WM, past 30-day alcohol consumption, and consequences of alcohol use were measured at baseline. According to the study, a person who starts drinking with the intention to stop or to avoid risks associated with uncontrolled drinking, would partly rely on WM to achieve this. This emphasises the significance of WM in controlling alcohol-related behaviours.

The researchers (Lechner et al., 2015) hypothesised that poor WM after alcohol consumption would be associated with greater self-reported drinks per drinking day. The researchers measured WM after each beverage administration with results indicating a relationship between increased alcohol intake per day and poor WM functioning. As the alcohol consumption increased, WM functioning declined. Since the study was conducted in a controlled laboratory environment, the findings on alcohol-induced changes in WM could not be generalised to natural drinking. The findings were, however, useful in demonstrating a link between individual differences in WM changes and increased alcohol consumption (Lechner et al., 2015).

A study by Deshpande, (2015), also looked at how alcohol consumption impacts WM. The study used a battery of cognitive tasks and a recreational drug use questionnaire to assess WM and alcohol consumption of 100 healthy adults. Results indicated an impact on various modalities of WM due to alcohol consumption. The results also showed that alcohol abstinence influenced recovery in mild WM impairments (Deshpande, 2015). This suggests that recovery is possible with WM impairments which is also supported by a study by Khemiri et al., (2018). The study focused on whether cognitive training impacted WM function and drinking in AUD patients. Results indicated that cognitive training could improve WM function in people with AUD (Khemiri et al., 2018). While these findings suggest the possibility of interventions that can be explored to administer to people with AUD, further studies should be conducted to evaluate their feasibility, practicality, and effectiveness.

The current study findings can also contribute to a better understanding of how WM is influenced by a period of abstinence, as part of a rehabilitation programme.

2.7 Abstinence and Recovery

The primary neuropsychological domains assessed in people with AUD have been memory, executive functions (attention, abstraction, problem-solving, organising, and planning, and inhibition), emotion and psychosocial skills, visuospatial cognition, and psychomotor abilities (Oscar-Berman et al., 2014). A review by Oscar-Berman et al., (2014), suggested that abstaining from alcohol intake over time shows that the brain appears to reorganise itself to offer compensation for structural and behavioural impairment. The neuropsychological profiles related to alcoholism vary since alcoholism has heterogeneous origins and outcomes and is influenced by various factors such as the history of the person's family, their mental and physical health, their gender, and age (Oscar-Berman et al., 2014).

In a study by Siccardi et al., (2014), a patient diagnosed with chronic alcoholism since adolescence, was assessed by repeated psychometric measures and clinical observations of behaviour and cognition. The cognitive remediation was carried out during a 10-month hospitalisation followed by an outpatient's rehabilitation setting over 12 months. Results showed an improvement in attentional processes and executive functions (Siccardi et al., 2014). The results from this study support evidence from a study by Kopera et al., (2012), which used assessments from the Cambridge Neuropsychological Assessment Automated Battery (CANTAB) to assess cognitive functions where a comparison was made of cognitive functions of abstaining alcohol-dependent male patients and healthy controls. The aim of the study by Kopera et al., (2012), was to determine whether cognitive performance varied in patients in relation to the length of abstinence. Results indicated that patients who were abstinent for less than one year made more errors in both attentional shifting and WM assessments than healthy controls and patients with longer durations of abstinence (Kopera et al., 2012). This emphasises the need to assess the cognitive abilities of patients over various periods of time. In a study by van Eijk et al. (2013), the patients were scanned within

the first 24 hours of detoxification and after 2 weeks of supervised abstinence. The results indicated recovery of volumetric amelioration within a few days after detoxification with variances between brain regions (van Eijk et al., 2013). Both studies by Kopera et al. (2012), and van Eijk et al. (2013), suggest that abstinence influences the general ability of recovery for different brain regions. There is, however, a need for further research to determine the degree to which designed cognitive remediation impacts alcohol-related cognitive impairments.

Another study by Ioime et al. (2018) focused on the recovery of cognitive deficits in the medium (6 months) and long term (12 months) after the interruption of drinking was evaluated in patients diagnosed with AUD. The changes in the observed neuropsychological measures were evaluated between a 1-year follow-up and controls data. The overall results indicated an improvement in all cognitive domains that were assessed after alcohol detoxification. The results from comparing the 1-year follow-up scores and controls data indicated a significant improvement in assessed cognitive domains except for general non-verbal intelligence, verbal memory, and certain visuospatial skills (Ioime et al., 2018). However, the impact of continued abstinence requires further research regarding clarifying the quality of recovery on different cognitive domains.

Despite the evidence on the different recovery levels of selective cognitive processes, some cognitive domains remain impaired even with prolonged abstinence (Le Berre et al., 2017). While evidence indicates that recovery is possible with prolonged abstinence, some people struggle to remain abstinent, which may impact their recovery from AUD. An investigative study by Loeber et al. (2010), focused on whether repeated withdrawal from alcohol affects recovery of cognitive functioning and if it is related to relapse. While no relationship with relapse was observed, the results of the study provided evidence that repeated episodes of withdrawal may be a risk factor for cognitive impairment and influence

cognitive recovery (Loeber et al., 2010). Findings from a study by Mlinarics, Kelemen, Sefcsik, and Németh (2009), indicated that the performance of certain cognitive domains impacted by alcohol abuse were related to the duration of the abstinent period, suggesting the recovery of these functions. Most patients diagnosed with AUD find it challenging to remain abstinent after discharge from rehabilitation centres. Abstinence is easier to maintain when the patients are in a controlled environment, but they face more challenges once control is autonomously motivated.

2.8 Conclusion

Various factors influence the success of therapy interventions for AUD patients, which include variations in treatment responses and the heterogeneity in how AUD is diagnosed (Batman, 2015). It is therefore important to highlight that there can be no generic approach to the treatment of AUD. Research is yet to produce adequate and sustainable solutions to manage or control AUD, however, research seems to suggest that some progress has been made.

Alcohol abuse is linked to several social and psychological problems (Brennan et al., 2020). Similarly, the consequences of abusing alcohol demonstrate a decline in numerous cognitive domains, especially abilities related to WM, and attention (Chai et al., 2018; Harvey et al., 2018). This chapter emphasised the extent to which WM, AR and VA abilities are moderated by alcohol use and the potential benefit of abstinence in improving these cognitive abilities. Literature supports the notion that abstinence may positively impact cognitive functioning, but what is yet to be established is the role of abstinence in the quality and extent of recovery on cognitive functioning, which was the main focus of the current study. The next chapter provides an outline of the theoretical framework and methodology used to guide the current research process.

CHAPTER 3 Theoretical Framework and Methodology

This chapter explores some relevant theories regarding alcohol consumption, specifically the social learning theory, personality, behavioural and cognitive behavioural theories. A detailed discussion of the main theoretical framework that guided the present study is also provided. The chapter also outlines the methodological approach and research procedure followed. The ethical principles that guided the researcher is discussed as well and an outline of the validity and reliability of the study is included.

3.1 Theoretical Framework

The theoretical framework needs to demonstrate an understanding of theories and concepts relevant to the research (Sacred Heart University, 2006). The first part of the chapter is dedicated to discussing theories important to the research topic and the second part will discuss the theoretical framework that was used to guide the current research process and interpret the findings. The researcher included the first section to contextualise the diverse nature of AUD and to highlight the multidimensional approach needed to treat AUD related problems.

3.1.1 The Social Learning Theory

In a social context, many individuals consume alcohol due to certain events or celebrations they may attend, such as weddings and parties. The social learning theory suggests that role modelling affects personal decisions and choices (Akers 2017). Through observation, one may learn that drinking is acceptable in social situations. According to the social learning theory, societal influences are important, and they focus on peer pressure and relationships.

The theory recognises that underlying reasons may cause people to frequently consume alcohol, hence this is one area addressed during alcohol rehabilitation (Akers , 2017). West and Brown, (2013), assessed the social learning theory and mentioned that if a person

believes that the observed behaviour may lead to a reward, they will eventually model that behaviour (West & Brown, 2013). For example, a person may be accepted into a certain social circle if they passed an initiation task such as taking multiple shots of alcohol. This person is likely to repeat the use of alcohol if it guarantees that they will continue to belong to that social circle.

One can, however, argue that this view is rather linear since the benefits of the social learning theory can be seen when adverse effects are demonstrated. For example, if the person takes these shots and experiences blackouts or nausea, they may avoid alcohol and rather exclude themselves from that social circle. The social learning theory emphasises the important role that social factors can play in initiating and maintaining alcohol use. The rehabilitation programme, that the patients in the current study were exposed to, included addressing psychosocial issues. The main focus of the current study was, however, primarily on the cognitive domain.

3.1.2 The Personality Theory

There is no one universal definition of personality, but it can be defined as a pattern of comparatively enduring traits and distinctive characteristics that render both regularity and uniqueness to a person's behaviour (Treleaven, 2015). The behaviour of an individual, the consistency of behaviour over time, and in different situations is determined by traits; these traits may be exclusive, or common to some group, or may be shared by an entire species (Feist & Feist, 2008).

Common trait patterns differ from one individual to another, making each person unique regarding their personality. Characteristics are peculiar qualities of a person and comprise aspects like temperament and intellect (Feist & Feist, 2008).

While the reasons for excessive alcohol consumption differ individually, the personality theory suggests that personalities influence the consumption of alcohol by different people (Treleaven, 2015). This theory is supported by Littlefield and Sher (2010), who summarised various theoretical models regarding the influence of personality on alcohol use disorders.The models are summarised in Table 1. The biggest gap regarding the personality theory and AUD, as emphasised by the article, is the need for further research to establish how and why personality relates to AUD (Littlefield & Sher, 2010).

Table 1: *Theoretical Models Focusing on Causal Effects of Personality on Alcohol (Littlefield & Sher, 2010)*

Model	Author(s)	Main themes of model
Deviance Proneness	Sher et al. (1999) Cooper et al. (2003) Krueger et al. (2002)	Substance use denotes an aspect of a broad pattern of deviant behaviours that start in childhood due to inadequate socialisation and genetic susceptibility.
Genetic Diathesis	Cloninger (1987) Slutske et al. (2002) Kendler et al. (2003)	Genetic risk for AUDs may be facilitated by personality.
Pharmacological Vulnerability	Sher, (1991) Cleckley, (1982); MacDougall, (1929)	People have different responses to severe and/or chronic effects of alcohol.
Personality and Environmental Selection	Park et al. (2009) Buss, (1987) Plomin et al. (1977)	Individuals are inclined to self-select into environments that are attuned to their own character or personality.
Affect Regulation	Cooper (1994) Cox & Klinger, (1988, 1990)	Drinking motives are characterised along two principal dimensions; reflecting source and the valence of the consequences a person hopes to achieve by drinking.

While there are various theories regarding the impact of personality on AUD, the complexity of human nature creates a challenge for researchers to conclude causal effects of personality on alcohol use and related problems. The importance of personal factors related to AUD is acknowledged by the researcher. The inclusion of this section emphasises the notion that several individual factors can impact AUD.

3.1.3 The Behavioural Theory

For a while behaviourism was the key influencer in how most cognitive psychologists approached their work, with a great focus on the prediction and control of behaviour (Meyer et al., 2010). Over the years, the work of Gestalt psychologists, cognitive theorists and social psychologists challenged the concept of behaviourism which led to more focus on internal brain processes (Przedborski et al., 2003). B.F. Skinner's (1904-1990) theory on behaviour is based on the concept of respondent and operant behaviour (Meyer et al.2010). Respondent behaviour refers to behaviour that results from a trigger or stimulus. The stimulus can be a change in the environment or an object that is observable. Operant behaviour is when behaviour is spontaneous at first but may be repeated based on the experience.

An example is a person who starts by only consuming alcohol at social gatherings. Social gatherings would be the discriminative stimulus for the alcohol consumption – this is respondent behaviour. Over time, the social drinker may learn to associate consuming alcohol with feeling good and the consumption of alcohol is now done to feel good even when the person is not at a social gathering – this is operant behaviour.

Operant conditioning is a process where a behaviour which proves successful in satisfying a need or deemed as positive is repeated (Meyer et al., 2010). This relates to classical conditioning as well since the drinker learns to associate the use of alcohol with social settings. The resulting pleasurable feeling is a reinforcing factor increasing the likely repeat of the

behaviour i.e., operant conditioning. Based on the theory of operant conditioning; if a person learns to associate alcohol abstinence with positive or pleasant experiences, this may reinforce the behaviour of abstinence.

The theories mentioned above were not used as the primary theoretical point of departure for the current study, however, the researcher acknowledges the importance of highlighting these theories to address the diverse use of alcohol and the potential factors that may contribute to the development of AUD. The main theory used to guide the present research study is discussed next.

3.1.4 The Cognitive Behavioural Theory

In the field of mental health, while the various techniques for treatment are emphasised, it is also important to understand the underlying theories. The literature review enabled the researcher to become familiar with various psychological theories and to get a better understanding of the behaviours associated with AUD. Research has indicated that treatment for AUD based on the cognitive-behavioural theory (CBT) is highly effective (Coates et al., 2013). CBT is a set of related theories from various sources such as clinical experience, empirical studies, and various mental health workers. The term *cognitive-behavioural* is the hybrid of cognitive processes and behavioural approaches which are used to achieve cognitive and behavioural change (Kalodner, 2011). There is no definite approach in CBT since various treatments can be classified under it, including cognitive therapy, problem-solving therapy, dialectical behaviour therapy, meta-cognitive therapy, rational-emotive behaviour therapy, cognitive processing therapy, mindfulness-based cognitive therapy, cognitive-behavioural analysis system of psychotherapy, and schema-focused therapy (Gaudiano, 2008).

At the core of cognitive behaviour theories are three basic assumptions:

1. Cognitive processes and content are available and are well known

2. Our thinking intermediates the way we respond to environmental prompts
3. Cognitions can be deliberately targeted, altered, and changed (González-Prendes & Resko, 2012)

The fundamental premise of CBT was established by Albert Ellis, who introduced the term rational emotive therapy (RET) in 1957 to highlight its focus on emotional outcomes. This was followed by Aaron Beck's creation of cognitive therapy (CT) in 1976, which served as the foundation for the development of Cognitive Behavioural Therapy (Misciagna, 2020). Cognitive behavioural therapy is based on CBT and the common principle is that mental disorders and psychological distress are maintained by cognitive factors. This common principle is supported by Beck (1970), one of the pioneers for CBT and maladaptive cognitions (Beck, 1970). According to Beck's model, these maladaptive cognitions include general beliefs, or schemas, about the world, the self, and the future, giving rise to specific and automatic thoughts in certain situations (Rangé & Marlatt, 2008).

A mental health professional who uses cognitive behavioural therapy as treatment would, for example, assist the patients diagnosed with AUD to consider the negative impact on relationships, physical health, and career if they continue to drink too much. After this, the mental health professional will guide the individual through managing discomfort like cravings for alcohol and consider healthier alternative behaviours instead (Cognitive Behavioral Therapy for Alcoholism Recovery, 2020). A study by Caneva et al., (2020), indicated the significance of including a cognitive functioning recovery intervention as part of AUD treatment.

The study focused on the qualitative description of cognitive deficits identified in early-detoxified AUD patients undergoing rehabilitation. Using the Brief Neuropsychological Examination 2 (ENB-2) as an assessment tool, the results indicated cognitive impairment in AUD patients (Caneva et al., 2020). The assumption regarding CBT and AUD assumes that

early experiences in life may be the foundation for the development of the disorder (Rangé & Marlatt, 2008). This is one reason why cognitive behavioural therapy has been identified as one of various successful approaches in AUD since it considers both interpersonal factors (social support, marital and family relationships, work relationships) and intrapersonal factors (cognitive processes and mood states) (Rangé & Marlatt, 2008). Through the detection of cognitive impairment, treatment interventions for AUD could be adapted so that patients with cognitive impairment are treated using an interdisciplinary approach.

3.1.5 Motivation for selected theoretical framework

CBT emphasises the incorporation of both cognitive processes and behavioural strategies with the goal of achieving cognitive and behavioural change; it refers to interventions that share common principles regarding mental disorders and psychological distress (Hofmann et al., 2012). Various elements motivate people to drink abusively. Some of these elements include perceptions or cognitions they have about alcohol and themselves and it is through studying these cognitions that the cognitive behavioural theory is useful in treating AUD. It expands beyond the traditional behaviour theory, which exclusively focuses on observable behaviours.

One view regarding CBT is that AUD is a learned behaviour, acquired the same way as any learned behaviour: by repeating the behaviours of role models because of the experience of positive effects from alcohol use (e.g., relieving pain, reduced anxiety, or enhanced social skills) or the expectation that alcohol has these effects (Monti et al., 2003). According to CBT, these learned behaviours can be altered through applying combined cognitive and behaviour approaches, which may assist patients with AUD to maintain sobriety (Kadden, 1994). This theory supports the importance of alcohol rehabilitation centres identifying the value of

incorporating cognitive functioning recovery interventions as part of AUD treatment instead of focusing only on psychosocial interventions.

Cognitive functioning plays a defining role in the initiation of alcohol use and the implications of alcohol abuse is evident in the decline of certain cognitive abilities (Abramowitz, 2013). From a CBT perspective it is necessary to consider the cognitive functioning of AUD patients in order to treat the various dimensions involved in alcohol abuse. Cognition essentially impacts on the social and psychological functioning of patients and it is necessary to explore the extent to which cognitive abilities are influenced by abstinence in order to enhance subsequent behavioural changes (Beck, 1970). CBT allows the researcher to emphasise the importance of cognition and to use this information as the basis for incorporating cognitive assessment and treatment interventions.

While the researcher is not focused on behavioural changes over time, the assumption is that improvement of cognitive functions may influence subsequent decisions to abstain from alcohol use i.e., behaviour. Through exploring the theories that influence AUD, there are greater opportunities for integrating these multiple theories in order to achieve a multidimensional approach in the treatment of AUD. The cognitive behavioural theory is therefore suited as a theoretical framework for this study since it is based on the idea that cognitions lead to behavioural change and the outcomes of treatment are based on cognitive, behavioural, and emotional changes (Kalodner, 2011).

3.2 Methodology

3.2.1 Research Design and Methodology

The research approach chosen for this study was quantitative. Quantitative research methods include using numbers and study phenomena that are measurable in a methodical way (Mertler, 2016). Quantitative research seeks to investigate relationships by selecting

variables about a phenomenon and data related to the chosen variables are then collected (Apuke, 2017). It is important to note that all research is questionable and remains debatable with an opportunity to be criticised in the future.

Quantitative research entails that relationships between independent and dependent variables are discovered and measured and causal inferences are often made (White & Sabarwal, 2014). The approach helps researchers to understand variables and relations which is achieved by using sampling, experimentation, measurement, and questionnaires.

From a critical realist perspective, the world as we know and understand is based on the observations we make through our perspectives and experiences. It is through understanding the causal effects of unobservable structures that one can understand the events caused by them (Warwick, 2020). The key benefit of using a quantitative approach is that the findings may demonstrate high validity and reliability depending on the design used. The findings can also apply to a wider population if the reliability is sufficient and a representative sample was included (Pham, 2018). While there are many advantages to using quantitative methods, the major disadvantages are that some issues studied in the social sciences like attitudes, intentions and thoughts are difficult to measure as they are impossible to observe. Another disadvantage to consider is that respondents may give false data by just giving random answers because the structured nature of the questions does not give them an opportunity to give their own nuanced responses (Kivunja & Kuyini, 2017). A quantitative approach was chosen because it allows for objective measurement and reporting of the study results. The researcher used a single group pretest-posttest design.

The single group pretest-posttest design involves taking measurements on the same subjects on two different occasions (Conaway, 1999). The foundation behind the single group pretest-posttest design includes acquiring a pretest measure of the outcome of interest before administering a treatment succeeded by a posttest on the same measure after the treatment

or intervention has been administered (Salkind, 2010). Pretest-posttest designs are mostly used in behavioural research, primarily to compare groups and/or measure change resulting from experimental interventions or treatments (Dimitrov & Rumrill, 2003).One of the advantages of the pretest-posttest design is that it deals with intact groups and therefore reduces the reactive effects of the experimental procedure and, may improve the external validity of the study. In relation to the current study, cognitive assessments were conducted before the AUD patients were exposed to the rehabilitation treatment programme to obtain a baseline measure. After several days of treatment, the same cognitive assessments were administered for the post-test measure.

3.2.2 Sampling

3.2.2.1 Sampling method

Purposive sampling, also called judgment sampling, is the deliberate choice of a participant due to the qualities the participant possesses. The main advantage of judgement sampling is that it does not need a set number of participants and the sampling method gives the researcher the latitude to determine what needs to be known; and discover participants who are able and inclined to provide the information needed by the researcher (Dudovskiy, 2018).

The method was also used because it allowed the researcher to use patients from the treatment centre who met the criteria. Purposive sampling was chosen because it offers the following advantages:

1. Purposive sampling is both time and cost effective
2. In this study there was a limited number of people who could provide the data that the researcher sought.

The researcher was also aware of the main risk of using purposive sampling, which is the limitation of generalising the results (Dudovskiy, 2018). In a research of this nature, it is difficult to get a big sample and therefore the researcher dealt with the sample size under limitations.

3.2.2.2 Selection criteria

Patient selection was based on availability and willingness to participate. They were sampled from the treatment centre. Purposive sampling was used with the following criteria guiding the selection: English speaking; 18+; formally diagnosed with AUD. The formal diagnosis of AUD was determined by the treatment facility and patients were assigned by the psychologist at the treatment centre according to diagnosis based on the assessment conducted by the psychologist.

Exclusion criteria for the patient group were being underage (<18 years old), presenting with a history of head injuries, current or past untreated neurological disorders and any abuse or dependence towards other substances, including psychotropic medication.

3.2.2.3 Sample size

The researcher assessed 16 patients diagnosed with AUD. The diagnosis of AUD was done by the appointed psychologist at the treatment centre. Although 16 patients were assessed, seven patients dropped out during Phase 2 due to COVID-19 lockdown regulations.

These patients could not be assessed during Phase 2 and were excluded from data analysis. The data presented is on the nine patients that were assessed for Phase 1 and 2.

3.2.3 Treatment Centre

The local treatment centre which the researcher worked with is a registered treatment centre for substance use disorders. It is one of few treatment centres in South Africa with the

ability to provide full multi-dimensional treatment services. The multi-disciplinary team includes the following professional members:

- Psychiatrist, medical practitioner, occupational and art therapist, and minister of religion – all working on a part-time basis
- Full-time psychologist and social workers
- Full-time professional nursing staff (24 hours a day)

The treatment of AUD at the treatment centre constitutes inpatients and outpatient options. There are three forms of rehabilitation interventions at the treatment centre namely:

- Alcohol Use Disorder (21 days)
- Drugs (35 days)
- Medication (28 days)

Approach for AUD rehabilitation:

- The duration for rehabilitation is 21 days and it is structured as follows:
  - Group therapy from Monday to Friday from (9:00 to 12:00)
  - In the afternoon occupational art therapy takes place with access to a psychiatrist available once a week

Therapy covering the progressive stages of the use of alcohol including the following:

- The extent that alcohol consumption has influenced the patients
- Emotional Intelligence and co-dependency
- Trust and how to restore it
- Relapse and relapse prevention

Table 2 summarises the scope of treatment for AUD at the treatment centre.

Table 2: *Summary Scope of Treatment for AUD*

First week	Second week	Final week	After discharge
Clinical intervention on arrival of the patients	• The patients spend time with the psychologist • Possible neurological impacts, psychopathologies and cognitive impairments identified by the psychologist are referred to a psychiatrist • The psychiatrist would generally also refer the Patients to an external mental health professional after discharge since the 21 days spent by the Patients for AUD is too short and not all identified cognitive impairments are substance induced	Family therapy sessions which include the patients	Three free sessions are available to the patients over three months after discharge where they can interact with the psychologist

Other critical elements relating to treatment involve methods of diagnosis and screening processes as well as determination of the stage or level of AUD in each of the patients. There is no inclusion of any cognitive functioning related treatment at the treatment centre, as with most rehabilitation centres for AUD. A core aspect of the treatment programme is also abstinence. The patients included in the present study were all received inpatient care and had to abstain from any alcohol during their 21-day treatment.

3.2.4 Data collection instruments

Before data collection could commence each patient was required to complete and sign an informed consent form (Appendix 3). Patients were also requested to complete a demographic questionnaire (Appendix 1). The demographic questionnaire contained questions regarding socio-demographic factors that the researcher used to ensure that all

patients met the selection criteria outlined in Section 3.2.2.2. The data collected from the demographic questionnaire was used for descriptive statistics of the patients as outlined in Section 4.1.1. The informed consent provided the patients with detailed information of the study. The most common question from patients was if the results would harm their reputation once the research paper was published. Patients were assured that privacy and confidentiality will be maintained, and that no personal information would be connected to the data. The patients were also informed that no physical or emotional harm will stem from participation in the research study and that ethical approval was obtained from the University which states that patients should not be harmed because of the research.

Voluntary participation was also emphasised, and the researcher collaborated with the appointed psychologist and nurse at the treatment centre for patient support. The WAIS-IV^{SA} was used as an instrument of assessment on the following cognitive functions: visuospatial attention, working memory, and abstract reasoning. This instrument provides advanced measures of cognitive ability and is a comprehensive measure of adult intelligence. This edition has been adapted to suit the needs of the South African population. The WAIS-IV^{SA} consists of 10 core subtests and five supplemental subtests, with the 10 core subtests comprising the Full-Scale IQ (JVR Africa Group, 2019). Below are the four index scales and core subtests:

- Verbal Comprehension Index (VCI): Similarities, Vocabulary, Information, and Comprehension
- Perceptual Reasoning Index (PRI): Block Design, Matrix Reasoning, Visual Puzzles, Picture Completion, and Figure Weights
- Working Memory Index (WMI): Digit Span, Arithmetic, and Letter-Number Sequencing
- Processing Speed Index (PSI): Symbol Search, Coding, and Cancellation

Assessments were administered by a registered psychometrist. The following subtests were administered to patients:

- Visuospatial attention: Block design
- Abstract reasoning: Matrix reasoning
- Working memory: Arithmetic

The psychometrist recommended that the researcher use the above three subtests since they were core in measuring the cognitive domains of this study. Another reason why the researcher used subtests is the advice from the appointed psychologist at the treatment center that patients would be at risk if subjected to lengthy assessments.

The WAIS-IV^{SA} is widely used by researchers and practitioners and has high consistency with the assessment-reassessment reliabilities which range from 0.70 (7 subscales) to 0.90 (2 subscales) over a two to twelve-week period (Statistics Solutions, 2019). Below is Tables 3 with the WAIS-IV^{SA} Psychometric Properties:

Table 3: *Reliability of the WAIS-IV Subtest, Indexes and FSIQ in the SA Validation Sample (Adapted)*

Measure	Total
VP	0.91
BD	0.89
MR	0.93
AR	0.88
DS	0.87
LN	0.89
PRI	0.94
WMI	0.90
FSQI	0.96

Note: Adapted from Wechsler, D. (2014). *Wechsler Adult Intelligence Scale: Fourth South African edition* (WAIS-IVSA). Johannesburg, South Africa: JvR Psychometrics (Pty) Ltd.

Appendix 5 indicates a summary of the WAIS-IV^{SA} tool.

3.2.5 Data collection procedure

The study was conducted in two phases. The researcher intended to conduct the assessment at three different phases, however, due to COVID19 related lockdown regulations, the collection procedure was revised to two phases. The basic premise behind the design involved obtaining a pretest and posttest measure of the sample. During data collection, each participant was required to manually complete the assessments in a designated room located at the treatment centre. Assessments were administered by a registered psychometrist. Only one participant was allowed at a time and the average time of completion per participant was approximately 30 minutes. The pre-assessment constituted the baseline measure before the treatment, and period of abstinence, was administered after which the psychometrist measured the patients again i.e., post-test measurement (Salkind, 2010).

The assessment process for the patients is outlined in the diagram below.

X = assessment **0** = treatment (rehabilitation and abstinence)

$\mathbf{X_0}$ (3 to 4 days after admission) **--- 0 ---** $\mathbf{X_1}$ (14 days after X_0)

Assessments were administered only after the signed consent form and demographic questionnaire was received. The reason for the 3 to 4 days delay before $\mathbf{X_0}$ is to allow for detoxification as per recommendation from the psychologist at the treatment center. The posttest ($\mathbf{X_1}$) occurs 14 days after $\mathbf{X_0}$ to allow for a period of abstinence during treatment. The psychologist at the treatment facility recommended post assessment occurs 14 days later.

3.2.6 Data analysis techniques

The goal of this research was to determine the relationship between abstinence and cognitive functioning, mainly to see how specific cognitive functions change due to abstinence.

Although the patients were exposed to a treatment including a psychosocial component, the main focus was on the abstinent part of the treatment, and not the treatment itself. Statistical analysis was conducted using IBM SPSS statistical software programme version 26. The software provides a wide range of analytics capabilities, including descriptive statistics and inferential statistics (IBM, 2017). The initial approach as indicated in 3.2.5 was a three phased assessment. However, since the data collection was revised to a two phased approach, a paired sample *t*-test or dependent sample *t*-test was used to analyse the data. The researcher ensured that no test assumptions were violated before statistical analysis. A paired sample *t*-test was used as the aim was to determine if the patient's group means are different and if the difference is statistically significant (Allen, 2017).

3.2.7 Quality criteria of the study

A good research design is important, and great attention must be paid towards the reliability and validity of the research. Internal and external validity are traditional aspects of research validity. Internal validity examines whether the design of the study, implementation, and analysis answer the research question objectively. Factors that addressed the internal validity of the study are discussed in Section 3.2.The external validity of a study examines whether the findings of the study can be generalised to other contexts and similar populations (Andrade, 2018). Results from this study will be analysed and discussed before making any assumptions on whether the findings can be generalised to other similar settings and people. Reliability refers to the uniformity of the measurement, or the degree to which the measuring instrument measures the same way each time it is used under the same conditions with a similar group of participants (Mohajan, 2017) . Reliability in this study was about the extent to which the data collection techniques and analysis procedures used yielded consistent

findings. Considering the various threats to reliability (Saunders et al., 2009), the researcher addressed the main ones as follows:

I. Participant error caused by environmental factors such as time and place were addressed through the researcher ensuring that all patients were assessed under similar conditions at the treatment centre.

II. Participant bias caused by participants responding according to what they believe is expected of them which was addressed through the use of a consent form which mentioned the confidentiality of the data collected and its intended use

Another aspect of validity that must be considered is statistical conclusion validity (SCV). The SCV is based on the adequate use of statistical methods to analyse data, that is, the extent to which data from research can be reasonably deemed as leading to a discovery (or lack thereof) between independent and dependent variables regarding statistical issues (García-Pérez, 2012). Various data analysis techniques were used in this research as outlined in Section 3.2.6. SCV also refers to rational inferences within a specified significance level (García-Pérez, 2012).

As indicated in Table 3 the WAIS-IV^{SA} has high consistency with the assessment-reassessment reliabilities ranging from 0.70 (7 subscales) to 0.90 (2 subscales) (Statistics Solutions, 2019). The WAIS-IV^{SA} can therefore be regarded as a valid and reliable test to measure various cognitive abilities. The researcher also ensured that all statistical assumptions were addressed before the specified statistical assessments were conducted.

3.3 Ethical Considerations

Ethics differentiate between right and wrong, and therefore guide human behaviour (Dongre & Sankaran, 2016). Before research was conducted, permission was first sought from the institution and the patients themselves. The researcher also received ethical clearance

from the Faculty of Humanities Ethics Committee at the University of Pretoria. Participants were required to sign a consent form before commencement of the study and the rights of the patients were clearly explained.

The researcher allocated numbers to each participant to ensure that no names where used, this also allowed for the researcher to track participants' results for pre- and posttest. The participants were informed of their right to discontinue their participation in the study at any given time should they feel inclined to do so with no penalties. Prior to conducting the study, the participants were informed about the reasons behind the study, their role, and how the results of the research would be used.

All matters regarding confidentiality, anonymity, data storage and distribution were outlined in the Participant Information Sheet and Participant Consent Form as indicated in Appendix 2 and Appendix 3. To ensure that patients were not exposed to any physical or mental harm, all psychological assessments were performed by a registered psychometrist at the treatment center in the presence of the staff.

Patients were informed that the data collected, and results will be stored at the University of Pretoria archive for a period of 15 years and may be used for future research, to which they consented through signing of the consent form.

3.4 Conclusion

The chapter detailed the theoretical framework that guided this study and briefly highlighted three other important theories namely: social learning theory, personality theory, and behavioural theory to contextualise the multidimensional nature of AUD. The cognitive behaviour theory was selected as the main theoretical point of departure for the current study with the second part of the chapter discussing the research design and methodology applied to this study.

The section discussed the sampling method, data collection instruments and procedure, validity and reliability of the study. The chapter concluded with a section devoted to the ethical considerations that guided this study. The next chapter includes the research results and how the data was analysed.

CHAPTER 4 Research Results and Data Analysis

This chapter gives a synopsis of the results that were obtained from the research. The chapter starts by describing the demographic characteristics of the patients then focuses on the results obtained after administering the assessments. A description of the patients' results, including the analysis of the collected data, will be covered.

4.1 Research Results

4.1.1 Socio-demographic variables of the patients

Table 5 below indicates the socio-demographic details of the patients followed by a brief description.

Table 4**:** *Socio-demographic Details of Patients*

Gender	[N]
Male	5
Female	4
Race	[N]
Black	0
White	8
Coloured	1
Indian	0
Educational background	[N]
No formal education	0
Grade 12 / Senior Certificate	7
College Certificate / Diploma	2
University Graduate	0

Description:

I. Gender - the sample comprised 45% females and 55% males.

II. Age - the age ranges were from 28 to 47 (*M* = 37.67, *SD* = 6.98).

III. Race – Majority of the participants were from the White people group at 90%, with 10% from the Coloured people group.

IV. Educational Background - there were 80% patients who completed their Grade 12 or Senior Certificate with 20% in possession of a diploma.

The data presented is on the nine patients that successfully completed both Phase 1 and 2. As such, data on patients who were unable to complete both phases has been omitted. Three cognitive domains were assessed: VA, AR, and WM. The results will be presented separately for each cognitive domain. The results include the patients' scores and completion times. Phase 1 focused on assessments that were administered 3 to 4 days after admission at the treatment centre. The reason for the 3 to 4 days delay before assessing the patients is to allow for detoxification period as recommended by the psychologist at the treatment center.

4.2 Patient (Phase 1) Scores and Completion Times

4.2.1 VA Scores and Completion Times

a. VA: Patient scores

In Table 6 below, the maximum allowable score was 66 and the patient group scores ranged between 24 and 40 (M = 32.30, SD = 7.26). The standard error of the mean (SEM) was 2.3 and margin of error was 32.3 ±4.499 (±13.93%) at 95% confidence level.

Table 5: *VA Total Raw Scores (Phase 1)*

Visuospatial attention total raw scores: Block design		
Patients	Patient score	Maximum Score
Patients 7	28	66
Patients 8	35	66
Patients 9	28	66
Patients 10	28	66
Patients 11	24	66
Patients 12	28	66
Patients 13	29	66
Patients 15	35	66
Patients 16	40	66

b. VA: Patient Completion times

As indicated in Table 7 below, the patient group had completion times between 7 and 14 minutes against a maximum allowable completion time of 16 minutes and 30 seconds (*M* = 8.67, *SD* = 1.50) at 95% level of confidence and the margin of error was 8.6667 ±0.98 (±11.31%) with a SEM of.50.

Table 6: *VA Completion Times (Phase 1)*

Completion times (min:s)		
Patients	Patient time	Maximum time
Patients 7	10:00	16:30
Patients 8	8:00	16:30
Patients 9	8:00	16:30
Patients 10	7:00	16:30
Patients 11	6:00	16:30
Patients 12	9:00	16:30
Patients 13	10:00	16:30
Patients 15	10:00	16:30
Patients 16	10:00	16:30

4.2.2 AR Scores and Completion Times

a. AR: Patient scores

For the patient group (Table 10) the lowest score was 7, while the highest was 15 (*M* = 10.89, *SD* = 3.14). The SEM is 1.28 and the margin of error is 10.8889 ±2.052 (±18.84%) at 95% confidence level.

Table 7: *AR Total Raw Scores (Phase 1)*

AR total raw scores: Matrix reasoning		
Patients	Patient score	Maximum score
Patients 7	13	26
Patients 8	13	26
Patients 9	12	26
Patients 10	14	26
Patients 11	7	26
Patients 12	7	26
Patients 13	15	26
Patients 15	8	26
Patients 16	9	26

b. AR: Patient completion times

As stated in Table 11, the completion times ranged between 3 and 11 minutes (*M* = 6.00, *SD* = 3.08). The standard deviation shows that the time taken to complete the tasks is widely dispersed with a range of 8. The SEM is 1.03 with a margin of error of 6 ±2.014 (±33.56%) at 95% confidence level.

Table 8: *AR Completion Times (Phase 1)*

Phase 1: Completion times (min:s)		
Patients	Patient time	Maximum time
Patients 7	11:00	14:00
Patients 8	3:00	14:00
Patients 9	6:00	14:00
Patients 10	8:00	14:00
Patients 11	3:00	14:00
Patients 12	6:00	14:00
Patients 13	10:00	14:00
Patients 15	4:00	14:00
Patients 16	3:00	14:00

4.2.3 WM Scores and Completion Times

a. WM: Patient scores

As indicated in Table 14 below, the lowest score against a possible total of 22 was 7, with the highest being 13, giving a range of 6 (*M* = 10.44, *SD* = 2.13). At 95% confidence interval and a SEM of 0.71 the margin of error is 10.4444 ±1.39 (±13.31%).

Table 9: *WM Total Raw Scores (Phase 1)*

WM total raw scores: Arithmetic		
Patients	Patient score	Maximum score
Patients 7	9	22
Patients 8	8	22
Patients 9	7	22
Patients 10	11	22
Patients 11	13	22
Patients 12	12	22
Patients 13	13	22
Patients 15	11	22
Patients 16	10	22

b. WM: Patient completion times

As indicated in Table 15 below, the completion time was between 3 and 12 minutes against a completion time of 11 minutes. The range for the patient group was 9 (*M* = 7.44, *SD* = 2.88). The SEM is 0.96 giving a margin of error of 7.4444 ±1.88 (±25.25%) at 95% confidence intervals.

Table 10: *WM Completion Times (Phase 1)*

Completion times (min:s)		
Patients	Patient time	Maximum time
Patients 7	3:00	11:00
Patients 8	6:00	11:00
Patients 9	7:00	11:00
Patients 10	11:00	11:00
Patients 11	6:00	11:00
Patients 12	9:00	11:00
Patients 13	12:00	11:00
Patients 15	5:00	11:00
Patients 16	8:00	11:00

4.3 Patient (Phase 2) Scores and Completion Times

Phase 2 focused on results for assessments that were administered 14 days after Phase 1. Phase 2 of assessments were conducted on two different days during 2020. Patients 7 to 13 were assessed on the same day, while patients 15 and 16 were assessed on a different day. The patient group had the same assessments administered as during Phase 1, that is, VA: Block Design; AR: Matrix Reasoning and WM: Arithmetic.

4.3.1 VA Scores and Completion Times

a) VA: Patient scores

The second Phase results show that the highest score was 49 and the lowest score was 28 out of the maximum score of 66. This gives a range of 21 (M = 36.67, SD = 6.98). The SEM is 2.33 and the margin of error at 95% confidence interval is 37.6667 ±4.562 (±12.11%).

Table 11: *VA Total Raw Scores (Phase 2)*

Total raw score VA: Block design		
Patients	Patient score	Maximum score
Patients 7	30	66
Patients 8	47	66

Total raw score VA: Block design		
Patients	Patient score	Maximum score
Patients 9	40	66
Patients 10	28	66
Patients 11	36	66
Patients 12	38	66
Patients 13	34	66
Patients 15	49	66
Patients 16	37	66

b) VA: Patient completion times

As shown in Table 19, the shortest time to complete the assessment was 5 minutes and the slowest was 12 minutes (M = 8.78, SD = 2.64). The SEM is 0.88 and at 95% confidence interval the margin of error is 8.7778 ±1.722 (±19.61%).

Table 12: *VA Completion Times (Phase 2)*

Completion time (min:s)		
Patients	Patient time	Maximum time
Patients 7	07:00	16:30
Patients 8	09:00	16:30
Patients 9	10:00	16:30
Patients 10	12:00	16:30
Patients 11	06:00	16:30
Patients 12	05:00	16:30
Patients 13	07:00	16:30
Patients 15	11:00	16:30
Patients 16	12:00	16:30

4.3.2 AR Scores and Completion Times

a) AR: Patient scores

The highest score was 19, and the lowest was 7 (Table 20), giving a range of 12 (*M* = 11.67, *SD* = 3.84). The SEM is 1.28 giving a margin of error of 11.6667 ±2.509 (±21.51%) at 95% confidence level.

Table 13: *AR Total Raw Scores (Phase 2)*

AR total raw scores: Matrix reasoning		
Patients	Patient score	Maximum score
Patients 7	11	26
Patients 8	17	26
Patients 9	19	26
Patients 10	10	26
Patients 11	9	26
Patients 12	7	26
Patients 13	10	26
Patients 15	11	26
Patients 16	11	26

b) AR: Patient completion times

As indicated in Table 21 below, none of the patients exceeded the maximum allowable completion time of 14 minutes (*M* = 5.44, *SD* = 2.07). The SEM is 0.69 with a margin of error of 5.4444 ±1.351 (±24.82%) at 95% confidence interval.

Table 14: *AR Completion Times (Phase 2)*

Completion times (min:s)		
Patients	Patient time	Maximum time
Patients 7	06:00	14:00
Patients 8	06:00	14:00
Patients 9	06:00	14:00
Patients 10	10:00	14:00
Patients 11	05:00	14:00
Patients 12	05:00	14:00

Completion times (min:s)		
Patients	Patient time	Maximum time
Patients 13	05:00	14:00
Patients 15	03:00	14:00
Patients 16	03:00	14:00

4.3.3 WM Scores and Completion Times

a) WM: Patient scores

As shown in Table 22 below, the lowest score was 10 and the highest is 15 (*M* = 11.56, *SD* = 1.59). This indicates minimum dispersion of the scores. The SEM is 0.53 and the margin of error at 95% confidence interval is 37.6667 ±4.562 (±12.11%).

Table 15: *WM Total Raw Scores (Phase 2)*

WM total raw scores: Arithmetic		
Patients	Patient score	Maximum score
Patients 7	10	22
Patients 8	11	22
Patients 9	11	22
Patients 10	15	22
Patients 11	13	22
Patients 12	11	22
Patients 13	12	22
Patients 15	11	22
Patients 16	10	22

b) WM: Patient completion times

As indicated in Table 23 below, the fastest time to complete the assessment was 2 minutes with the slowest being 10 minutes (*M* = 6.33, *SD* = 2.35). The SEM is 0.78 and the margin of error is 6.3333 ±1.532 (±24.19%) at 95% confidence interval.

Table 16: *WM Completion Times (Phase 2)*

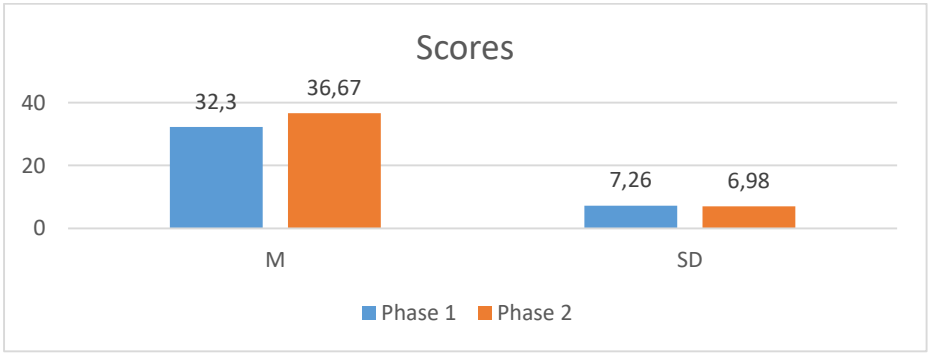
Completion times (min:s)		
Patients	Patient time	Maximum time
Patients 7	02:00	11:00
Patients 8	04:00	11:00
Patients 9	08:00	11:00
Patients 10	08:00	11:00
Patients 11	06:00	11:00
Patients 12	06:00	11:00
Patients 13	10:00	11:00
Patients 15	06:00	11:00
Patients 16	07:00	11:00

4.4 Comparison of Phase 1 and 2 Patient Scores and Completion Times

a. VA: Patient Scores

Figure 1 below indicates that the patients scored higher in Phase 2 (*M* = 36.67, *SD* = 6.98) compared to Phase 1 (*M* = 32.30, *SD* = 7.26). Over 70% of the patients scored higher in Phase 2. This suggests that after the intervention the mean score in the patient group increased for visuospatial attention. The significance of this increase will be determined by the inferential statistical analysis.

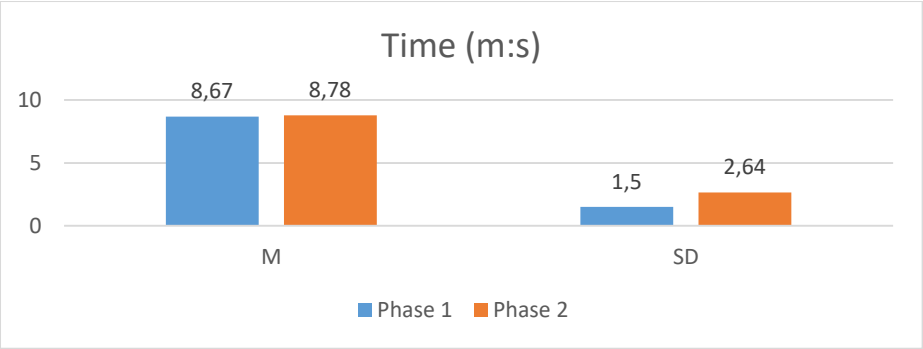
Figure 1: *VA Comparison of Phase 1 and 2 Scores*



b. VA: Patient Completion Times

As indicated in Figure 2 below, during Phase 2, the fastest completion time was 5 minutes with the slowest being 12 minutes. The completion time for Phase 2 increased (*M* = 8.78, *SD* = 2.64) compared to Phase 1 (*M* = 8.67, *SD* = 1.50).

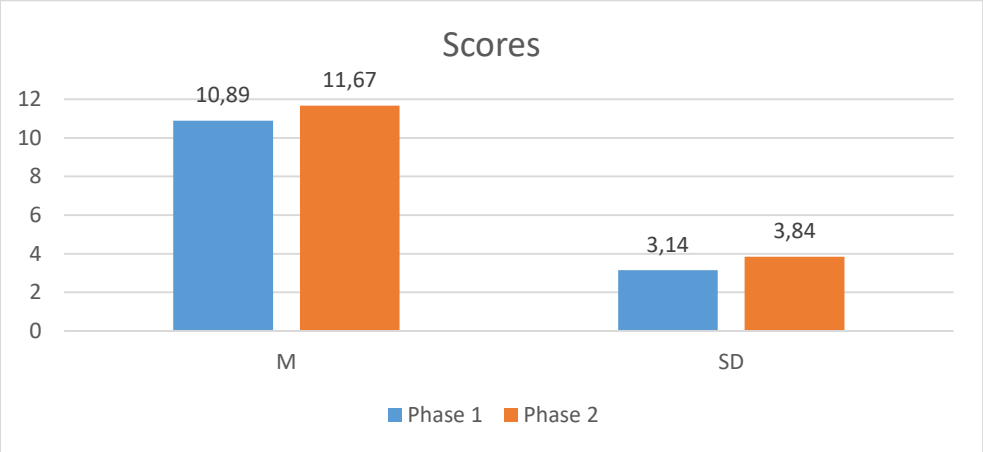
Figure 2: *VA Comparison of Phase 1 and 2 Completion Times*



a. AR: Patient Scores

As indicated in Figure 3 below, there was an improvement in abstract reasoning from Phase 1 (*M* = 10.89, *SD* = 3.14) to Phase 2 (*M* = 11.67, *SD* = 3.84). Additional analysis will determine whether this was statistically significant.

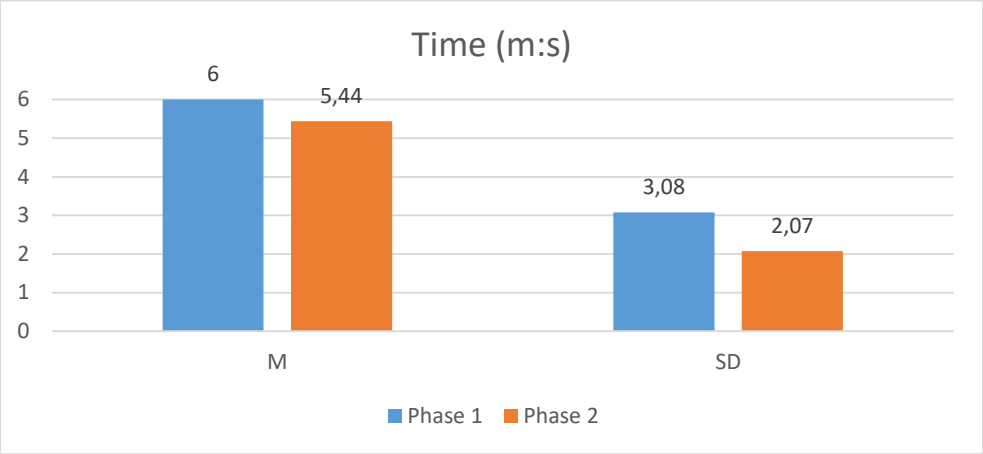
Figure 3: *AR Comparison of Phase 1 and 2 Scores*



b. AR: Patient Completion Times

As indicated in Figure 4 below, there was a decrease in completion time from Phase 1 (*M* = 6.00, *SD* = 3.08) compared to Phase 2 (*M* = 5.44, *SD* = 2.07).

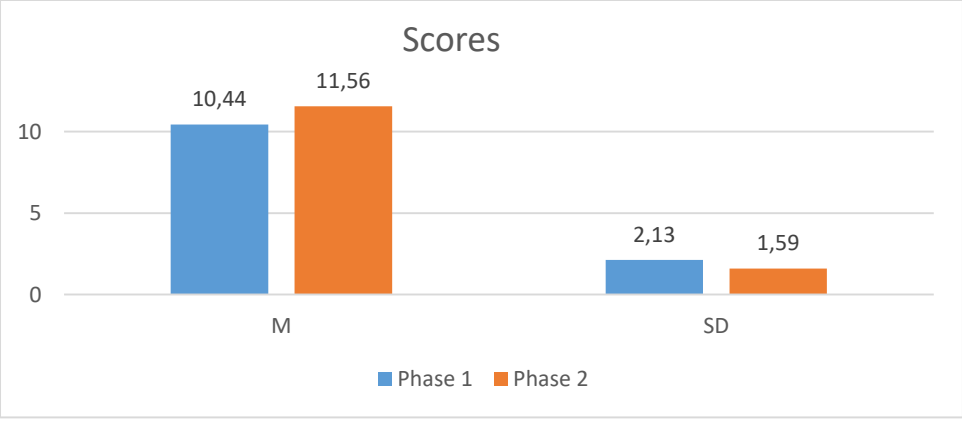
Figure 4: *AR Comparison of Phase 1 and 2 Completion Times*



a. WM: Patient Scores

As indicated in Figure 5, there was an increase in WM performance from Phase 1 (*M* = 10.44, *SD* = 2.13) to Phase 2 (*M* = 11.56, *SD* = 1.59). Additional analysis will determine whether this was statistically significant.

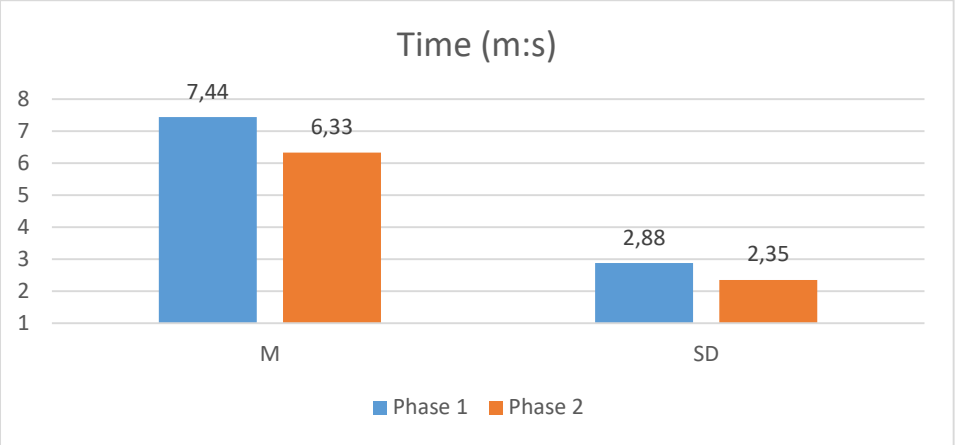
Figure 5: *WM Comparison of Phase 1 and 2 Scores*



b. WM: Patient Completion Times

As indicated in Figure 6, there was a decrease in completion time from Phase 1 (*M* = 7.44, *SD* = 2.88) to Phase 2 (*M* = 6.33, *SD* = 2.35).

Figure 6: *WM Comparison of Phase 1 and 2 Completion Times*



The aim of the study was to show how alcohol impacts cognition (pre-test) and how abstinence may potentially improve cognition (post-test) of AUD patients using WAIS-IV^{SA}. Whether the differences in assessment scores between Phase 1 and 2 are statistically significant will be determined by the paired sample *t*-test, which will be discussed in the following section.

4.5 Paired Sample *t*-test Results per Cognitive Function for Patient Group Scores (Phase 1 and 2)

This section focuses on the paired sample *t*-tests that were carried out based on the observed results. A paired sample *t*-test was conducted to evaluate the impact of alcohol abstinence on the patient groups' cognitive functioning. The paired sample t-test was used to determine if the difference in group's means for Phase 1 and 2 were statistically significant. The statistical analysis of the assessment results focused on patient group Phase 1 and 2 to establish if alcohol abstinence impacted patients' performance in the selected cognitive assessments. The means and standard deviations indicated below refer to the mean difference scores and the associated standard deviations. All the tests were carried out at 5% level of significance.

4.5.1 Paired sample t-test for VA

There was a statistically significant difference in the VA scores of patients when comparing Phase 1 and 2 (M = 7.11, SD = 2.07), $t(8) = 3.42$, $p = .009$. This means that after the period of abstinence, the patients' scores improved. The mean increase in the VA scores was 7.11 with a 95% confidence interval ranging from -4.7918 to 4.7918. The researcher acknowledges that the interval is wide and contains 0 indicating a poor estimate of the population value. This means there is a great likelihood that no significant difference will be found should the same study be repeated. The eta squared statistic (1.14) indicated a large effect size suggesting that the magnitude of the difference between the average and μ0 is large. The researcher used Cohen's description to interpret the observed effect sizes. The general guidelines for Cohen's d are small = 0.20, medium = 0.50, and large = 0.80 (Cohen, 1992; Pallant, 2016).

4.5.2 Paired sample t-test for AR

There was no significant difference in the AR scores when comparing Phase 1 and 2 (M = 0.77, SD = 1.29), $t(8) = .59$, $p = .566$. This means that after the period of abstinence, the patients' scores did not significantly improve. The eta squared statistic (0.2) indicated a small effect size suggesting that the magnitude of the difference between the average and μ0 is small (Cohen, 1992).

4.5.3 Paired sample t-test for WM

There was no significant difference in the WM scores when comparing Phase 1 and 2 (M = 1.11, SD =.67), $t(8) = 1.64$, $p = .138$. This means that after the period of abstinence, the patients' scores did not significantly improve. The eta squared statistic (0.55) indicated a medium effect size. This indicates that the magnitude of the difference between the average and μ0 is medium (Cohen, 1992).

4.6 Conclusion

This chapter presented the results of the cognitive performance tests for the patient group. The demographic characteristics of the patient group was discussed, followed by an overview of the descriptive statistics. Findings were presented for Phase 1, pretest measure, and 2, posttest measure for the patient group. The chapter concluded with a presentation of the paired sample *t*-test results with a focus on the patients' assessment scores between Phase 1 and 2 to determine the statistical significance of the differences observed.

The next chapter provides an interpretation of the results and addresses the research question and hypotheses according to the aim and objectives identified.

CHAPTER 5 Discussion and Limitations

This chapter provides a comprehensive discussion on the interpretation of the results, their implication and general contribution to the discipline, and alignment with relevant literature. The researcher endeavoured to answer the following research question: *"To what extent do the working memory abilities, abstract reasoning and visuospatial attention skills of adults diagnosed with AUD improve after alcohol abstinence?"* This chapter discusses the findings in relation to the primary aim and objectives of the study. The main aim of the study was to evaluate the impact of alcohol abstinence, as part of a treatment programme, on cognitive functioning, specifically, visuospatial attention, working memory and abstract reasoning during two phases using the WAIS-IV^{SA} battery.

The study objectives were as follows:

1. To assess the extent to which working memory ability in AUD patients is improved by abstinence.
2. To assess the extent to which visuospatial attention in AUD patients is improved by abstinence.
3. To assess the extent to which abstract reasoning in AUD patients is improved by abstinence.

5.1 Interpretation of the Findings in Relation to Specific Cognitive Functions

The researcher attempted to determine if a period of alcohol abstinence improved the cognitive functioning of AUD patients. Chapter 4 provided comparative data of the patients (Phase 1 and 2).

5.1.1 Visuospatial Attention

Visuospatial attention is an adaptive mechanism in a complex multisensory world allowing a person to pursue specific goals while being able to respond to and process stimuli in the

surrounding environment (Doruk et al., 2018). Visuospatial attention involves the selection of information in relation to where stimuli are in space (Zirnsak & Moore, 2015). The assessment administered for visuospatial attention was the Block Design (BD) which has the longest administration time of any Perceptual Reasoning subtest, and one of the longest of all subtests in the scale (Raiford et al., 2010). The performance of BD is timed and requires the examinee to use three-dimensional blocks to construct a model from a two-dimensional stimulus card (Bettcher et al., 2011). The administration requires the use of both a model and the Stimulus Book picture.

H1: Alcohol abstinence improves the visuospatial attention ability of AUD patients.

The first hypothesis included evaluating whether the visuospatial attention ability of patients improved after a period of abstinence, as part of the treatment programme they were exposed to.

When comparing the completion times and scores for the patient group for Phase 1 and 2, there is an increase in the mean for completion time and scores. This indicates that, while the time to complete the assessment increased during Phase 2, the scores also improved. The increase in performance from Phase 1 to 2 was indicated as significant based on the results from the paired sample *t*-test.

Results suggest that after the 14-day period of abstaining from alcohol, the visuospatial attention performance scores in the patient group increased which correlates with the findings from Siccardi et al. (2014). The researchers focused on patients diagnosed with chronic alcoholism since adolescence. Patients were assessed by means of repeated psychometric measures and clinical observations of behaviour, and cognition over a long period. Results from the study showed an improvement in the attentional processes and executive functions of the patients. In relation to the current study, the researcher's observation during the

visuospatial attention assessment was that the patient group struggled with concentration during the assessment, especially during Phase 1.

A similar study by do Canto-Pereira et al. (2007), examined how acute alcohol intoxication affects the spatial distribution of visual attention in alcohol groups and controls. The study noted in agreement that the alcohol group struggled with concentration. The results concluded that prolonged use of alcohol is responsible for the impairment of performance in tasks that require sustained attention. Likewise, Zehra et al. (2019) investigated the neural responses of 19 recently abstinent patients diagnosed with AUD and 23 healthy controls on a visual attention task using fMRI. The results indicated decreased visual attention activation in the brain regions of the patients compared to controls.

Based on the results of this study, there was a significant increase in patients' mean scores for visuospatial attention skills which improved after a period of abstinence from alcohol. These results correlate with various studies which investigated the impact of alcohol abstinence on visuospatial attention skills (Cabe et al., 2016; Fein et al., 1990; Fein & Cardenas, 2015; Pelletier et al., 2016; Zehra et al., 2019). The researcher, however, acknowledges the small sample size and the possibility of confounding variables. No causal conclusions are made and the significant difference obsevered with regard to VA is to be interpreted within the current sample limitations.

5.1.2 Abstract Reasoning

Abstract Reasoning (AR) refers to the ability to quickly identify patterns, logical rules, and trends in new data, followed by integration and application of this information to solve problems (Astorga, 2013). It also involves problem-solving and reasoning for problems to which there are no familiar solutions (Shakeel & Goghari , 2017). The assessment administered to assess abstract reasoning was the Matrix Reasoning task. This is a nonverbal reasoning task in which

individuals are asked to identify patterns in designs. This subtest measures nonverbal reasoning skills, broad visual intelligence and perceptual organisation skills (Bettcher et al., 2011).

H2: Alcohol abstinence improves the abstract reasoning ability of AUD patients.

The second hypothesis included evaluating whether the AR ability of patients improved after a period of abstinence. When comparing the completion times and scores for the patient group for Phase 1 and 2, the mean score for the patient group slightly increased to $M = 11.67$. The increase in performance from Phase 1 to Phase 2 was, however, not significant based on the results from the paired sample *t*-test. This means that after the period of abstinence, based on the patient group scores, the period of abstinence did not appear to significantly impact the AR abilities of the patients. The short time period of 14 days might have influenced the results. More details on the limitations of the study will be discussed in Section 5.2 of this chapter. A study, through the use of fMRI, indicated that alcohol-dependent participants used additional brain areas to execute behavioural demands for the same task performance compared to controls (Bagga et al., 2014). There was, however, no significant difference in their response accuracy. This suggests that although alcohol-dependent participants could complete the tasks, it took more effort from them using additional brain areas. This may have been the case in this study since the participants were able to complete the assessment within the allocated time, but at a neurological level, they may have relied on additional brain areas; however, more research is needed to determine whether this was the case as this was not assessed in the present study.

No definitive conclusions are made as the researcher acknowledges the possibility of other confounding variables that may have influenced the results due to the lack of experimental rigour and control in the study.

5.1.3 Working Memory Discussion

Working memory is defined as the "…ability to retain limited amount of information in a readily accessible form and it facilitates planning, comprehension, reasoning, and problem-solving" (Cowan, 2014, p. 198). The assessment administered for WM was Arithmetic, which includes 22 timed arithmetic problems to be solved without using a calculator or pencil and paper. This subtest measures calculation skills, problem-solving skills, mental manipulation of number operations and working memory (Bettcher et al., 2011).

H3: Alcohol abstinence improves the working memory ability of AUD patients.

The third hypothesis included evaluating whether the WM ability of patients improved after a period of abstinence. When comparing the completion times and scores for the patient group for Phase 1 and 2, there was an increase in the average completion time and scores. This indicates that, while the time to complete the assessment increased during Phase 2, the scores also improved. The increase in performance from Phase 1 to 2 was, however, not significant based on the results from the paired sample *t*-test. This means that after the period of abstinence, the patient group achieved a mean score similar to Phase 1. These results correlate with findings from a study which used a computation span task comparing light social drinkers with heavy social drinkers where there was no significant group difference in the results (Montgomery et al., 2012). Another example is the study which administered multiple WM tasks to patients diagnosed with AUD with the results showing no significant group differences (Goudriaan et al., 2006).

H0: There is no statistically significant improvement in the cognitive functioning, specifically visuospatial attention, abstract reasoning, and working memory of AUD

patients following abstinence.

Based on the data and the statistical analysis, the null hypothesis is true for AR and WM. No statistically significant differences were found for AR and WM performance for the patient group before and after alcohol abstinence. A statistically significant improvement for VA was found, which may provide some support for the hypothesis that a period of alcohol abstinence and treatment may possibly improve this cognitive functioning domain. As noted, the small sample size and potential confounding variables prevents any definitive conclusions.

The cognitive behavioural theory guided the current study and maintains that early detection of cognitive impairment due to AUD, can inform treatment centres about optimal treatment options. Using an interdisciplinary approach during treatment generally provides the best results (Rangé & Marlatt, 2008). Detection of cognitive impairment is essential so that rehabilitation treatment can be adapted for improved clinical outcomes (Caneva et al., 2020). According to CBT, human thoughts are changeable, by doing this the emotions and behavioural aspects can also be changed (Kalodner, 2011). Treatment programmes mainly target the psychosocial aspects of AUD, but as CBT maintains, the cognitive aspects also need to be considered to enable successful behaviour change. One of the basic assumptions of CBT is that cognitions can be deliberately targeted, altered, and changed (González-Prendes & Resko, 2012), suggesting that interventions that are targeted at a specific impaired cognitive domain may yield effective results that influence prolonged alcohol abstinence.

5.2 Limitations

This section details some limitations experienced during the current research process and the subsequent impact on the interpretation of the results. This section allows the reader to have a broader understanding of the context in which the data was collected and to provide recommendations to improve future research. Results obtained were not compared with

associated variables of alcoholism such as severity of dependence, duration of alcohol intake and quantity of alcohol consumption. These associated variables were intentionally omitted since the focus of the study was on alcohol abstinence as an influence on cognitive improvement irrespective of dosage and frequency of alcohol intake. The researcher was also reliant on the availability of patients and their willingness to participate. Accounting for the duration of alcohol use and how much and how often alcohol is consumed was therefore difficult.

The researcher conducted a thorough literature review to better understand AUD and the different variables that are considered during rehabilitation. The researcher also used objective assessment measures and relied on statistical analysis to report the findings. The scientific integrity of the research process was maintained by using valid and reliable assessments and appropriate statistical analysis. The assessment was also conducted by a qualified psychometrist.

One of the prominent limitations concerns the short period of pre-and-post assessment. The researcher initially intended to explore the impact of alcohol abstinence on the specified cognitive domains over an extended period. A baseline assessment would have been conducted 3 to 4 days following admission, a second assessment before discharge and a follow-up assessment 3 months after discharge. The intention was to determine the impact of prolonged alcohol abstinence on cognitive functioning, given the lack of research related to this and the uncertainty regarding the extent to which cognitive abilities recover.

The national lockdown regulations implemented due to COVID-19, however, not only delayed the process of data collection and the number of patients admitted to the treatment centre, but also resulted in changes to the initial data collection procedure due to time constraints. This also resulted in patient attrition as some patients could not be available to

complete the assessments for Phase 2 and the researcher was forced to exclude these patients from analysis. These challenges resulted in a smaller sample than anticipated.

Another limitation concerning the small sample size relates to the availability of rehabilitation centres willing to participate. The researcher was also reliant on a qualified psychometrist to physically administer the assessments. Availability of patients and their willingness to partake in the study also limited the number of patients included in the sample.

Results from the current study may encourage more alcohol-related rehabilitation centres to participate in future research and to recognise the significance of the cognitive domain and incorporate cognitive functioning interventions into their rehabilitation programmes.

To caution against the limitations outlined, the researcher did not make any definitive conclusions regarding the results obtained, and a few recommendations are offered to improve future research.

CHAPTER 6 Conclusion and Recommendations

The discussion of the findings addressed the main research question as well as the hypotheses and null hypothesis through the interpretation of the results. The researcher's aim was to show how alcohol impacts cognition (pre-test) and how abstinence, which was part of the treatment programme, may potentially improve cognition (post-test).The focus was not on the treatment itself, but merely the abstinence component related to the treatment and how this may influence the cognitive impairment due to alcohol abuse.

The researcher constructed the main research question to unravel the relationship between abstinence and cognitive impairment. Researchers in the field of alcohol addiction reported that recovery from alcohol dependence includes different brain functions and behavioural changes associated with different stages of abstinence (Cui et al., 2015). The results from the study showed improvement when Phase 1 and 2 data was compared, although this was not statistically significant. This suggests that recovery may be progressive but at varying degrees for each patient and the rate of recovery may be domain dependent. VA abilities may thus show a faster improvement compared to WM and AR abilities.

These results support evidence from a study by Kopera et al. (2012), where a comparison of cognitive functions of abstaining alcohol-dependent male patients and healthy controls was done (Kopera et al., 2012). The results from this study also correlate with findings from the study by Ioime et al. (2018) which indicated a significant improvement in assessed cognitive domains except for general non-verbal intelligence, verbal memory, and certain visuospatial skills (Ioime et al., 2018).

The current results indicated that there was a marked improvement from Phase 1 to 2 in patient's assessment scores after abstinence, specifically for visuospatial attention. This conclusion is, however, considered within the study limitations and more research is needed to ascertain the degree of this improvement. Through evaluating the impact of abstinence on AUD patients, this study contributes to current literature, especially in the South African

context, by expanding on knowledge regarding the impact of alcohol abstinence on cognitive functioning.

The results highlighted the importance of considering cognitive aspects during treatment of AUD. Findings from this research can contribute in assisting treatment centre that are considering the inclusion of cognitive components in the assessment and treatment of AUD. The findings also contribute to understanding the quality of recovery on different cognitive domains through continued abstinence (Cui et al., 2015; Ioime et al., 2018; Kopera et al., 2012).

A multidisciplinary approach that deals with psycho-affective, behavioural, and cognitive consequences, in line with the cognitive behavioural theory, is thus needed when treating AUD (Siccardi et al., 2014). It is, therefore, recommended that research should not only focus on the improvement of assessment results over the abstinence period, but incorporate measures that evaluate the extent and quality of the improvements.

Given the short period of alcohol abstinence in the current study, and the inability to conduct a Phase 3 follow-up assessment, it is possible that longer periods of abstinence may yield significant improvement in WM and AR functioning. However, the findings of this study are not to be generalised based on the limitations discussed. Future research in this field should comprise a larger sample and prolonged period of abstinence to improve the generalisability of the study findings.

References

Abramowitz, J. S. (2013). The Practice of Exposure Therapy: Relevance of Cognitive-Behavioral Theory and Extinction Theory. *ScienceDirect Behavior Therapy, 44*(4), 548-558. www.sciencedirect.com

Akers , R. L. (2017). *Social learning and social structure : a general theory of crime and deviance.* New York: Routledge.

Allen, M. (2017). The sage encyclopedia of communication research methods. *SAGE, 1-4*. doi:10.4135/9781483381411

Andrade, C. (2018). Internal, External, and Ecological Validity in Research Design, Conduct, and Evaluation. *Indian J Psychol Med., 40*(5), 498-499. doi:10.4103/IJPSYM.IJPSYM_334_18

Apuke, O. D. (2017). Quantitative Research Methods : A Synopsis Approach. *Arabian Journal of Business and Management Review, 6*(10), 40-47. doi:10.12816/0040336

Armstrong, R. J., & Barker , R. A. (2001). Neurodegeneration: a failure of neuroregeneration? *The Lancet*, pp. 1174-1176. doi:10.1016/S0140-6736(01)06260-2

Astorga, M. L. (2013). Alcoholism and conditional reasoning: difficulties in specific mental domains or in the general use of heuristics? *Psychologica Belgica, 53*(4), 3-16. doi:10.5334/pb-53-4-3

Baddeley, A. (2000). The episodic buffer: a new component of working memory? *Trends in Cognitive Sciences, 4*(11), 417-423. doi:10.1016/S1364-6613(00)01538-2

Bagga , D., Singh, N., Singh , S., Modi , S., Kumar , P., Bhattacharya , D., & Garg , M. (2014). Assessment of abstract reasoning abilities in alcohol-dependent subjects: an fMRI study. *Neuroradiology*, 69-77. doi:10.1007/s00234-013-1281-3

Banerjee, N. (2014). Neurotransmitters in alcoholism: A review of neurobiological and genetic studies. *Indian Journal of Human Genetics, 20*(1), 20–31. doi:10.4103/0971-6866.132750

Bates, M. E., Buckman, J. F., & Nguyen, T. T. (2013). A Role for Cognitive Rehabilitation in Increasing the Effectiveness of Treatment for Alcohol Use Disorders. *Neuropsychol Rev.*, 27–47. doi:10.1007/s11065-013-9228-3

Batman, A. M. (2015). Translating Alcohol Research: Opportunities and Challenges. *Alcohol Research, 37*(1), 7–14. www.ncbi.nlm.nih.gov/pmc/articles/PMC4476605/

Beck, A. T. (1970). Cognitive therapy: Nature and relation to behavior therapy. *ScienceDirect, 1*(2), 184-200. doi:10.1016/S0005-7894(70)80030-2

Bernadin, F., Maheut-Bosser, A., & Paille, F. (2014). Cognitive impairments in alcohol-dependent subjects. doi:https://doi.org/10.3389/fpsyt.2014.00078

Bettcher, B. M., Libon, D. J., Swenson, R., & Penney, D. L. (2011). Block Design. In *Encyclopedia of Clinical Neuropsychology.* New York: Springer.

Bettcher, B. M., Libon, D. J., Swenson, R., & Penney, D. L. (2011). Block Design. In *Encyclopedia of Clinical Neuropsychology.* New York: Springer.

Brennan, S., McDonald, S., Page, M., Reid, J., Ward, S., Forbes, A., & McKenzie, J. (2020). Long-term effects of alcohol consumption on cognitive function: a systematic review and dose-response analysis of evidence published between 2007 and 2018. *Systematic Reviews, 9*(33). doi:10.1186/s13643-019-1220-4

Breukelaar, I., Antees, C., Grieve , S., Foster, S., Gomes, L., Williams , L., & Korgaonkar , M. (2017). Cognitive control network anatomy correlates with neurocognitive behavior: A longitudinal study. *Human Brain Mapping, 38*(2), 631-643. doi:10.1002/hbm.23401

Breukelaar, I., Antees, C., Grieve , S., Foster, S., Gomes, L., Williams , L., & Korgaonkar , M. (2017). Cognitive control network anatomy correlates with neurocognitive behavior: A longitudinal study. *Human Brain Mapping, 38*(2), 631-643. doi:10.1002/hbm.23401

Brust, J. (2010). Ethanol and cognition: indirect effects, neurotoxicity and neuroprotection: a review. *PubMed*, 1540-57. doi:10.3390/ijerph7041540

Buri, C., Franz, M., Anna , G., & Werner , S. (2007). Prescription procedures in medication for relapse prevention after inpatient treatment For Alcohol Use Disorders in Switzerland. *Alcohol & Alcoholism, 42*(4), 333–339. doi:10.1093/alcalc/agm038

Cabe, N., Laniepce, A., Ritz, L., Lannuzel, C., Boudenhent, C., Vabret, F., . . . Pitel, A. (2016). Cognitive impairments in alcohol dependence: From screening to treatment improvements. *PubMed*, 74-81. doi:10.1016/j.encep.2015.12.012

Caneva, S., Ottonello, M., Torselli, E., Pistarini, C., Spigno, P., & Fiabane , E. (2020). Cognitive Impairments in Early-Detoxified Alcohol-Dependent Inpatients and Their Associations with Socio-Demographic, Clinical and Psychological Factors: An Exploratory Study. *Dovepress, 20*(16), 1705-1716. doi:https://doi.org/10.2147/NDT.S254369

Centre for Innovation in Research and Teaching. (2010). *CIRT.* https://cirt.gcu.edu/research/developmentresources/research_ready/quantresearch/overview_quant

Centre for Neuroscience in Education. (2019). *Centre for Neuroscience in Education*. https://www.cne.psychol.cam.ac.uk/math-memory/intro-to-working-memory-part-1

Chai, W., Hamid, A., & Abdullah, J. (2018). Working Memory From the Psychological and Neurosciences Perspectives: A Review. *Frontiers in Psychology, 9*(401). doi:10.3389/fpsyg.2018.00401

Coates, J. M., Gullo, M. J., Feeney, G. F., Young, R. M., & Connor, J. P. (2013). A Randomized Trial of Personalized Cognitive-Behavior Therapy for Alcohol Use Disorder

in a Public Health Clinic. *Frontiers in Psychiatry*. doi:https://doi.org/10.3389/fpsyt.2018.00297

Cohen, J. (1992). Statistical Power Analysis. *Current Directions in Psychological Science, 1*(3), 98–101. doi:10.1111/1467-8721.ep10768783

Conaway, M. (1999). Repeated Measures Design. biostat.app.vumc.org/wiki/pub/Main/ClinStat/repmeas.PDF

Cowan, N. (2014). Working Memory Underpins Cognitive Development, Learning, and Education. *Educ Psychol Rev., 26*(2), 197–223. doi:10.1007/s10648-013-9246-y

Crossroads Recovery Centres. (2016). *Crossroads Recovery Centres*. http://crossroadsrecovery.co.za/types-of-addiction/alcohol-abuse/

Cui, C., Noronha, A., Warren, K., Koob, G. .., Sinha, R., Thakkar, M., . . . Sullivan, E. V. (2015). Brain Pathways to Recovery from Alcohol Dependence. *PMC US National Library of Medicine National Institutes of Health, 49*(5), 435–452. doi:10.1016/j.alcohol.2015.04.006

Datta, S., & Roy, D. D. (2015). Abstract reasoning and Spatial Visualization in Formal. *International Journal of Scientific and Research Publications, 5*(10), 2250-3153. www.ijsrp.org/research-paper-1015/ijsrp-p4648.pdf

Demirakca, T., Ende, G., Kämmerer, N., Welzel-Marquez, H., Hermann, D., Heinz, A., & Mann, K. (2011). Effects of alcoholism and continued abstinence on brain volumes in both genders. *Alcohol Clin Exp Res., 35*(9), 1678-85. doi:10.1111/j.1530-0277.2011.01514.x

Deshpande, S. S. (2015). Differential Effects of Alcohol Consumption Behaviours on Working Memory Processes. *Journal of European Psychology Students, 6*(3), 14–23. doi:10.5334/jeps.dd

Devere, R. (2016). The Cognitive Consequences Of Alcohol Use. *Practical Neurology*. https://practicalneurology.com/articles/2016-oct/the-cognitive-consequences-of-alcohol-use

Diana, M. (2011). The dopamine hypothesis of drug addiction and its potential therapeutic value. *Front in Psychiatry, 2*(64), 1-7. doi:10.3389/fpsyt.2011.00064

Dimitrov, D., & Rumrill, P. (2003). Pretest-posttest designs and measurement of change. *PUBMED, 2*(20), 159-65. https://pubmed.ncbi.nlm.nih.gov/12671209/

do Canto-Pereira, L., de P A David, I., Machado-Pinheiro, W., & Machado-Pinheiro, R. (2007). Effects of acute alcohol intoxication on visuospatial attention. *Human & Experimental Toxicology, 26*, 311-319. doi:10.1177/0960327106070490

Dongre, A. R., & Sankaran, R. (2016). Ethical issues in qualitative research: challenges and options. *International Journal of Medical Science and Public Health*, (5)6, 1187-1194. www.bibliomed.org/mnsfulltext/67/67-1445233327.pdf?1621346724

Dopamine and Alcohol Dependence: From Bench to Clinic. (2016). In N. Jayaram-Lindström, M. Ericson, P. Steensland, & E. Jerlhag, *Dopamine and Alcohol Dependence: From Bench to Clinic* (pp. 82-114). doi:10.5772/63144

Doruk, D., Chanes, L., Malavera, A., Merabet, L. B., Valero-Cabré, A., & Fregni, F. (2018). Cross-modal cueing effects of visuospatial attention on conscious somatosensory perception. *Heliyon, 4*(4), 1-18. doi:10.1016/j.heliyon.2018.e00595

Drijgers, R. L., Aalten, P., Winogrodzka, A., Verhey, F. R., & Leentjens, A. F. (2009). Pharmacological Treatment of Apathy in Neurodegenerative Diseases: A systemic Review. *Dement Geriatr Cogn Disord.* 28(1), 13-22. doi: 10.1159/000228840

Dudovskiy, J. (2018). The ultimate guide to writing a dissertation in bussiness studies: a step-by-step assistance. The Role of GABAA Receptors in the Development of

Alcoholism. *Pharmacology, biochemistry, and behavior, 90(1), 95–104. doi:, 90*(1), 95–104. doi:10.1016/j.pbb.2008.03.007

Erdozain, A. M., Morentin, B., Bedford, L., King, E., Tooth, D., Brewer, C., . . . Carter, W. G. (2014). *Alcohol-Related Brain Damage in Humans.* Carlifornia: Plos One. doi:10.1371/journal.pone.0093586

Fals-Stewart, W., & Lam, W. K. (2010). Computer-Assisted Cognitive Rehabilitation for the Treatment of. *Experimental and Clinical Psychopharmacology, 18*(1), 87–98. doi:10.1037/a0018058

Fein, G., & Cardenas, V. A. (2015). Neuroplasticity in Human Alcoholism: Studies of Extended Abstinence with Potential Treatment Implications. *Alcohol Research, 37*(1), 125–141. www.ncbi.nlm.nih.gov/pmc/articles/PMC4476599/

Fein, G., Bachman, L., Fisher, S., & Davenport, L. (1990). Cognitive impairments in abstinent alcoholics. *Western Journal of Medicine, 152*(5), 531–537. www.ncbi.nlm.nih.gov/pmc/articles/PMC1002406/

Feist, J., & Feist, G. J. (2008). *Theories of Personality* (7th ed.). US: The McGraw−Hill Companies, Inc.

Foxcroft, C., & Roodt, G. (2013). *Introduction to Psychological Assessment in the South African Context.* Cape Town: Oxford University Press.

García-Pérez, M. A. (2012). Statistical Conclusion Validity: Some Common Threats and Simple Remedies. *Front Psychol., 3*, 325. doi:10.3389/fpsyg.2012.00325

Gaudiano, B. A. (2008). Cognitive-Behavioral Therapies: Achievements and Challenges. *Evid Based Ment Health., 11*(1), 5–7. doi:10.1136/ebmh.11.1.5

Gilbertson, R., Prather, R., & Nixon, S. (2008). The Role of Selected Factors in the Development and Consequences of Alcohol Dependence. *Alcohol research & health : the*

journal of the National Institute on Alcohol Abuse and Alcoholism, 31(4), 389–399. www.ncbi.nlm.nih.gov/pmc/articles/PMC3860467/

Global Drug Survey. (2014). *Global Drug Survey*. www.globaldrugsurvey.com/past-findings/the-global-drug-survey-2014-findings/

González-Prendes, A., & Resko, S. (2012). Part I Theoretical Frameworks. In *Cognitive-Behavioral Theory* (pp. 14-40).

Gorgulu, Ö., & Şahinler, S. (2006). Repeated Measures Analysis and Some Experimental Design Considerations. *ResearchGate*, 78-97. www.researchgate.net/publication/234115340

Goudriaan, A., Oosterlaan , J., de Beurs , E., & van den Brink , W. (2006). Neurocognitive functions in pathological gambling: a comparison with alcohol dependence, Tourette syndrome and normal controls. *Addiction, 101*(4), 534-47. doi:doi: 10.1111/j.1360-0443.2006.01380.x.

Gunn, R., Gerst, K., Wiemers, E., Redick , T., & Finn, P. (2018). Predictors of Effective Working Memory Training in Individuals with Alcohol Use Disorders. *Alcohol Clin Exp Res., 42*(12), 2432-2441. doi:10.1111/acer.13892

Handley , M., Lyles, C., McCulloch , C., & Cattamanchi , A. (2018). Selecting and Improving Quasi-Experimental Designs in Effectiveness and Implementation Research. *Annu Rev Public Health, 1*(39), 5-25. doi:10.1146/annurev-publhealth-040617-014128

Harper, C. (1998). The Neuropathology of Alcohol-specific Brain Damage, or Does Alcohol Damage the Brain? *Journal of Neuropathology and Experiemntal Neurology*, 57(2), 101-110. doi.org/10.1097/00005072-199802000-00001

Harvey, A. J., Bayless, S. J., & Hyams, G. (2018). Alcohol increases inattentional blindness when cognitive resources are not consumed by ongoing task demands. *Psychopharmacology, 235*(1), 309–315. doi:10.1007/s00213-017-4772-9

Hofmann, S. G., Asnaani, A., Vonk, I. J., Sawyer, T. A., & Fang, A. (2012). The Efficacy of Cognitive Behavioral Therapy: A Review of Meta-analyses. *Cognit Ther Res., 36*(5), 427–440. doi:10.1007/s10608-012-9476-1

Houston, R. J., Derrick, J., Leonard, K., Testa, M., Quigley, B., & Kubiak, A. (2014). Effects of Heavy Drinking on Executive Cognitive Functioning in a Community Sample. *Addictive Behaviours, 39*(1), 345–349. www.ncbi.nlm.nih.gov/pmc/articles/PMC4101901/

Hulac, D., Benson, N. F., & Kranzler, J. (2010). Independent examination of the Wechsler Adult Intelligence Scale-Fourth Edition (WAIS-IV): what does the WAIS-IV measure? *Pschological Assessment, 22*(1), 121-130. doi:10.1037/a0017767

IBM. (2017). *IBM Corporation.* [IBM SPSS Statistics Edition]. www.ibm.com/downloads/cas/ELALKA4N

Ickx, G., Bleyenheuft, Y., & Hatem, S. M. (2017). Development of Visuospatial Attention in Typically Developing Children. *Frontiers in Psychology, 8*(2064), 1-14. doi:10.3389/fpsyg.2017.02064

Ioime, L., Guglielmo, R., Affini, G. F., Quatrale, M., Martinotti, G., Callea, A., . . . Janiri, L. (2018). Neuropsychological Performance in Alcohol Dependent Patients: A One-Year Longitudinal Study. *Psychiatry Investig, 15*(5), 505–513. doi:10.30773/pi.2017.09.27.1

Jhangiani, R., & Chiang, I.-C. (2015). Research Methods in Psychology. *Research Methods in Psychology* (Chapter 7). https://opentextbc.ca/researchmethods/part/nonexperimental-research/

Jones, A., McGrath, E., Robinson, E., Houben, K., Nederkoorn, C., & Field, M. (2018). A Randomized Controlled Trial of Inhibitory Control Training for the Reduction of Alcohol Consumption in Problem Drinkers. *Journal of Consulting and Clinical Psychology, 86*(12), 991–1004. doi:10.1037/ccp0000312

Jurado-Barba, R., Martínez, A., Sion, A., Álvarez-Alonso, M. J., Robles, A., Quinto-Guillen, R., & Rubio, G. (2017). Development of a screening test for cognitive impairment in alcoholic population: TEDCA. *Actas Esp Psiquiatr, 45*(5), 201-217. www.actaspsiquiatria.es/repositorio/19/109/ENG/19-109-ENG-201-17-481776.pdf

JVR Africa Group. (2019). Wechsler Adult Intelligence Scale® – Fourth SA Edition (WAIS®-IV SA). https://jvrafricagroup.co.za/catalogue/assessment/wechsler-adult-intelligence-scale-fourth-sa-edition-wais-iv-sa/

Kadden, R. M. (1994). Cognitive-Behavioral Approaches to Alcoholism Treatment. *Alcohol health and research world, 18*(4), 279-286. www.ncbi.nlm.nih.gov/pmc/articles/PMC6876446/

Kalodner, C. R. (2011). Cognitive-behavioral theories. *Counseling and Psychotherapy: Theories and Interventions* (pp. 193-213). https://psycnet.apa.org/record/2010-18469-009

Kanchan, G. S., Hannan, A., Mujeeb, M. M., Patel, S., & Sequeira, R. (2016). Medical Treatment of Alcohol Dependence. *Journal of Evolution of Research in Medical Pharmacology, 2*(1), 13-20. www.jermp.com/latest-articles.php?at_id=10

Khemiri, L., Brynte, C., Stunkel, A., Klingberg, T., & Jayaram-Lindström, N. (2018). Working Memory Training in Alcohol Use Disorder: A Randomized Controlled Trial. *Alcoholism: Clinical & Experimental Research, 43*(1), 135-146. doi:https://doi.org/10.1111/acer.13910

Kivunja, C., & Kuyini, A. B. (2017). Understanding and Applying Research Paradigms in Educational Contexts. *International Journal of Higher Education, 6*(5), 1927-6052. doi:10.5430/ijhe.v6n5p26

Koob, G. F., & Volkow, N. D. (2010). Neurocircuitry of Addiction. *Neuropsychopharmacology, 35*(1), 217–238. doi:10.1038/npp.2009.110

Kopelman, M. D., Thompson, A. D., Guerrini, I., & Marshall, J. (2009). The Korsakoff Syndrome: Clinial Aspects, Psychology and Treatment. *Oxford Academic*, 44(2), 148-154. doi:10.1093/alcalc/agn118

Kopera, M., Wojnar, M., Brower, K., Glass, J., Nowosad, I., Gmaj, B., & Szelenberger, W. (2012). Cognitive functions in abstinent alcohol-dependent patients. *US National Library of Medicine National Institutes of Health, 46*(7), 665-71. doi:10.1016/j.alcohol.2012.04.005

Krishna, A., & Strack, F. (2017). Reflection and Impulse as Determinants of Human Behavior. *Knowledge and Action*, 145-167. doi:doi.org/10.1007/978-3-319-44588-5_9

Lazarevic, L. B., Knezevic, G., Mitic, M., & Jocic, D. D. (2018). Psychometric properties of the Serbian version of the Wechsler Adult Intelligence Scale-Fourth Edition (WAIS-IV). *PSIHOLOGIJA*, 1-17. doi:https://doi.org.10.2298/PS1171001001L

Le Berre, A.-P., Fama, R., & Sullivan, E. V. (2017). Executive Functions, Memory, and Social Cognitive Deficits and Recovery in Chronic Alcoholism: A Critical Review to Inform Future Research. *Alcoholism, clinical and experimental research, 41*(8), 1432-1443. doi:10.1111/acer.13431

Lechner, W. V., Day, A. M., Metrik, J., Leventhal, A. M., & Kahler, C. W. (2015). Effects of Alcohol-Induced Working Memory Decline on Alcohol Consumption and Adverse Consequences of Use. *Psychopharmacology (Berl), 233*(1), 83-88. doi:10.1007/s00213-015-4090-z

Leverson, R. W., Sturm, V. E., & Haase, C. M. (2014). *Emotional and behavioural symptoms in neurodegenerative disease: A model for studying the neural bases of psychopathology, 10,* 581-606. doi: 10.1146/annurev-clinpsy-032813-153653

Littlefield, A. K., & Sher, K. J. (2010). The Multiple, Distinct Ways that Personality Contributes to Alcohol Use Disorders. *Soc Personal Psychol Compass, 4*(9), 767–782. doi: 10.1111/j.1751-9004.2010.00296.x

Loeber, S., Duka, T., Márquez, H. W., Nakovics, H., Heinz, A., Mann, K., & Flor, H. (2010). Effects of Repeated Withdrawal from Alcohol on Recovery of Cognitive Impairment under Abstinence and Rate of Relapse. *Alcohol and Alcoholism, 45*(6), 541–547. doi:10.1093/alcalc/agq065

Mertler, C. A. (2016). *Introduction to Educational Research (Chapter 7),* 107-143. https://us.sagepub.com/sites/default/files/upm-binaries/70019_Mertler_Chapter_7.pdf

Meyer, W., Moore, C., & Viljoen, H. (2010). *Personology: From individual to ecosystem.* Johannesburg: Heinemann.

Mha, H., & Zhu, G. (2014). The dopamine system and alcohol dependence. *Ahanghai Archives of Psychiatry*, 26(2), 61-68. doi:10.3969/j.issn.1002-0829.2014.02.002

Misciagna, S. (2020). Introductory Chapter: Definition of Cognitive Behavioral Therapy and Its Principal Applications. In *Cognitive Behavioral Therapy.* doi:10.5772/intechopen.90139

Mlinarics, R., Kelemen, O., Sefcsik, T., & Németh, D. (2009). Cognitive impairment in patients with alcoholism after long-term abstinence. *Neuropsychopharmacol Hung, 11*(3), 135-9. https://pubmed.ncbi.nlm.nih.gov/20128392/

Mocaiber, I., David, I. A., de Oliveira, L., Pereira, M. G., Volchan, E., Figueira, I., . . . Machado-Pinheiro, W. (2011). Alcohol, Emotion and Attention: Revisiting the Alcohol Myopia Theory. *Psicologia: Reflexão e Crítica, 24*(2), 403-410. doi:10.1590/S0102-79722011000200022

Mohajan, H. K. (2017). Two Criteria for Good Measurements in Research: Validity and Reliability. *Munich Personal RePEc Archive, 17*(3), 58-82. https://mpra.ub.uni-muenchen.de/83458/

Molnar, S. M., Beaton, L. E., Happer, J. P., Holcomb, L. A., Huang, S., Arienzo, D., & Marinkovic, K. (2018). Behavioral and Brain Activity Indices of Cognitive Control Deficits in Binge Drinkers. *Brain Sciences, 8*(1), 9. doi:10.3390/brainsci8010009

Montgomery, C., Murphy, P. N., Fisk, J. E., Ryland, I., & Hilton, J. (2012). The effects of heavy social drinking on executive function: a systematic review and meta-analytic study of existing literature and new empirical findings. *National Library of Medicine, 27*(2), 187-199. doi:doi: 10.1002/hup.1268

Monti, P., Abrams, D., & Litt, M. (2003). *Cognitive-Behavioural coping skills therapy manual.* (M. E. Mattson, Ed.) www.pubs.niaaa.nih.gov

Nathan, P. E., Wallace, J., Zweben, J., & Horvath, T. (2018). *American Psychological Association.* https://www.apa.org/helpcenter/alcohol-disorders

NIAAA. (2016). *National Institute on Alcohol Abuse and Alcoholism (NIH Publication No. 13–7999).* https://pubs.niaaa.nih.gov/publications/dsmfactsheet/dsmfact.pdf

Oscar-Berman, M., Valmas, M. M., Sawyer, K. S., Ruiz, S. M., Luhar, R. B., & Gravitz, Z. R. (2014). Profiles of Impaired, Spared, and Recovered Neuropsychological Processes in Alcoholism. *Handbook of Clinical Neurology, 125*, 183–210. doi:10.1016/B978-0-444-62619-6.00012-4

Pallant, J. (2016). *SPSS Survival Manual: A Step By Step Guide to Data Analysis Using SPSS Program* (6th ed.). London, UK: McGraw-Hill Education.

Pelletier, S., Nalpas, B., Alarcon, R., Rigole, H., & Perney, P. (2016). Investigation of Cognitive Improvement in Alcohol-Dependent Inpatients Using the Montreal Cognitive Assessment (MoCA) Score. *Journal of Addiction, 2016*. doi:https://doi.org/10.1155/2016/1539096

Pham, L. T. (2018). *A review of advantages and disadvantages of three paradigms: positivism, interpretivism and critical inquiry.* University of Adelaide. doi:10.13140/RG.2.2.13995.54569

Przedborski, S., Vila, M., & Jackson-Lewis, V. (2003). Series Introduction: Neurodegeneration: What is it and where are we? *The Journal of Clinical Investigation*, 111(1), 3–10. doi: 10.1172/JCI17522

Psytech SA. (n.d.). www.psytech.co.za/images/PsytechSA/ART/art%20factsheet.pdf

Raiford, S. E., Coalson, D. L., Saklofske, D. H., & Weiss, L. G. (2010). Practical Issues in WAIS-IV Administration and Scoring (Chapter 2). *WAIS-IV Clinical Use and Interpretation* (pp. 25-59). ScienceDirect.

Ranes, B. (2015). *Butler Center for Research.* https://www.hazelden.org/web/public/document/bcrup_1106.pdf

Rangé, B. P., & Marlatt, A. G. (2008). Cognitive-behavioral therapy for alcohol and drug use disorders. *Brazilian Journal of Psychiatry, 30*(2), 88-95. doi:10.1590/S1516-44462008000600006

Rauch, S., & Foa, E. (2006). Emotional Processing Theory (EPT) and Exposure. *J Contemp Psychother, 36*, 61-65. doi:DOI 10.1007/s10879-006-9008-y

Rehm, J., Hasan, O. S., Black, S. E., Shield, K. D., & Schwarzinger, M. (2019). Alcohol use and dementia: a systematic scoping review. *Alzheimer's Research & Therapy, 11*(1), 1-11. doi:10.1186/s13195-018-0453-0

Sacred Heart University. (2006). *Organising Academic Research Papers: Theoretical Framework*. https://library.sacredheart.edu/c.php?g=29803&p=185919

Salkind, N. J. (2010). *Encyclopedia of Research Design*. doi:10.4135/9781412961288

Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research Methods for Business Students.* England: Pearson Education Limited.

Shakeel, M. K., & Goghari , V. M. (2017). Measuring Fluid Intelligence in Healthy Older Adults. *Journal of Aging Research*. doi: 10.1155/2017/8514582

Siccardi, L., Vautel-Pons, D., Dos Santos, M., Camus, N., & Louchart de la Chapelle, S. (2014). Secondary benefits of cognitive rehabilitation for a chronic ethylic patient: effects on disorder consciousness, motivation, and global therapeutic cooperation. *Encephale, 40*(3), 263-70. doi:10.1016/j.encep.2013.03.007

Spithoff, S., & Kahan, M. (2015). Primary care management of alcohol use disorder and at-risk drinking. *Canadian Family Physician, 61*(6), 509–514. www.ncbi.nlm.nih.gov/pmc/articles/PMC4463891/

Statistics Solutions. (2019). Wechsler Adult Intelligence Scale—Fourth Edition (WAIS–IV). www.statisticssolutions.com/wechsler-adult-intelligence-scale-fourth-edition-wais-iv/

Sullivan, E. V., Harris, R. A., & Pfefferbaum, A. (2010). Alcohol's Effects on Brain and Behavior. *Alcohol research & health : The journal of the National Institute on Alcohol Abuse and Alcoholism, 33*(1-2), 127-143. www.ncbi.nlm.nih.gov/pmc/articles/PMC3625995/

Topiwala, A., Allan, C., Valkanova, V., Zsoldos, E., Filippini, N., Sexton, C., . . . Ebmeier, K. (2017). Moderate alcohol consumption as risk factor for adverse brain outcomes and cognitive decline: longitudinal cohort study. *BMJ (Clinical research ed.), 357*. doi:10.1136/bmj.j2353

Treleaven, T. M. (2015). *An examination of some theories that address the heavy alcohol consumption of university students*. Sudbury: Laurentian University. https://pdfs.semanticscholar.org/dd59/408cda7d81fe260b97a428ef113c9d57bb17.pdf

van Eijk, J., Demirakca, T., Frischknecht, U., Hermann, D., Mann, K., & Ende, G. (2013). Rapid partial regeneration of brain volume during the first 14 days of abstinence from alcohol. *Alcohol Clin Exp Res., 37*(1), 67-74. doi:10.1111/j.1530-0277.2012.01853.x

Velayudhan, R., & Saraswathy, S. (2020). Neuropsychological Functions in Short-and Long-term Alcohol Abstinence. *Indian Journal of Private Psychiatry, 14*(1), 26-29. doi:10.5005/jp-journals-10067-0054

Wagner, C., Kawulich, B., & Garner, M. (2012). *Doing Social Research A global context.* Berkshire: McGraw-Hill Education.

Warwick. (2020). *What is Critical Realism?* UK: Warwick. https://warwick.ac.uk/fac/soc/ces/research/current/socialtheory/maps/criticalrealism

West, R., & Brown, J. (2013). *Theory of Addiction.* London: Wiley Blackwell.

White , H., & Sabarwal, S. (2014). *Quasi-experimental Design and Methods, Methodological Briefs: Impact Evaluation 8*. Florence, US. www.unicef-irc.org/publications/pdf/brief_8_quasi-experimental%20design_eng.pdf

Wiers, R. W., Ames, S. L., Hofmann, W., Krank, M., & Stacy, A. W. (2010). Impulsivity, impulsive and reflective processes and the development of alcohol use and misuse in adolescents and young adults. *Frontiers in Psychology*, 1, 144. doi:https://doi.org/10.3389/fpsyg.2010.00144

Wilcox, C. E., Dekonenko, C. J., Mayer, A. R., Bogenschutz, M. P., & Turner, J. A. (2014). Cognitive control in alcohol use disorder: deficits and clinical relevance. *Rev Neurosci., 25*(1), 1-24. doi:10.1515/revneuro-2013-0054

Woods, A. J., Porges, E. C., Bryant, V. E., Seider, T., Gongvatana, A., Kahler, C. W., . . . Cohen, R. A. (2016). Current Heavy Alcohol Consumption is Associated with Greater Cognitive Impairment in Older Adults. *Alcoholism: Clinical and Experimental Research, 40*(11), 2435-2444. doi: https://doi.org/10.1111/acer.13211

Zahr, N. M., Pitel, A.-L., Chanraud, S., & Sullivan, E. V. (2010). Contributions of Studies on Alcohol Use Disorders to Understanding Cerebellar Function. *Neuropsychol Review, 20*(3), 280-289. doi:10.1007/s11065-010-9141-y

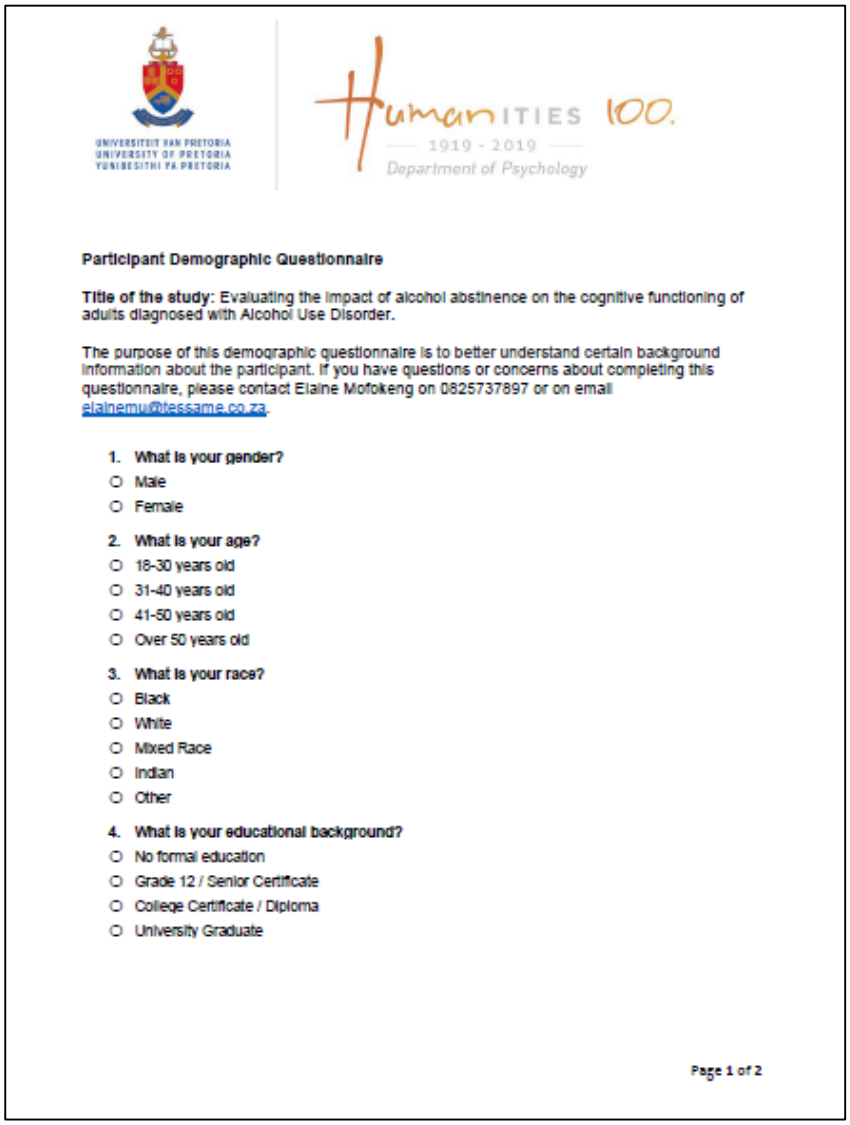
Zehra, A., Lindgren, E., Wiers, C. E., Freeman, C., Miller, G., Ramirez, V., . . . Volkowab, N. D. (2019). Neural correlates of visual attention in alcohol use disorder. *ScienceDirect, 194*, 430-437. doi:10.1016/j.drugalcdep.2018.10.032

Zieff, C. D., Schwartz-Bloom, R. D., & Williams, M. (2016). *Understanding Fetal Alcohol Spectrum Disorders (FASD): A Comprehensive Guide for Pre-K-8 Educators.* Durham: Duke University. https://sites.duke.edu/fasd/chapter-5-the-fasd-student-and-learning-issues/difficulty-with-abstract-and-conceptual-thinking/

Zirnsak, M., & Moore, T. (2015). The What and Where of Visual Attention. *Neuron, 88*(4), 626-8. doi:10.1016/j.neuron.2015.11.005

Appendices

Appendix 1: Demographic Questionnaire



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Humanities 100.
1919 - 2019
Department of Psychology

Participant Demographic Questionnaire

Title of the study: Evaluating the impact of alcohol abstinence on the cognitive functioning of adults diagnosed with Alcohol Use Disorder.

The purpose of this demographic questionnaire is to better understand certain background information about the participant. If you have questions or concerns about completing this questionnaire, please contact Elaine Mofokeng on 0825737897 or on email elainemu@tlessame.co.za.

1. **What is your gender?**
   - ○ Male
   - ○ Female
2. **What is your age?**
   - ○ 18-30 years old
   - ○ 31-40 years old
   - ○ 41-50 years old
   - ○ Over 50 years old
3. **What is your race?**
   - ○ Black
   - ○ White
   - ○ Mixed Race
   - ○ Indian
   - ○ Other
4. **What is your educational background?**
   - ○ No formal education
   - ○ Grade 12 / Senior Certificate
   - ○ College Certificate / Diploma
   - ○ University Graduate

Page 1 of 2

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Humanities 100.
1919 - 2019
Department of Psychology

5. Are you currently on any prescribed medication? (If yes, please specify)

6. Have you ever been admitted to hospital for any head injuries in the past two years? (If yes, please specify)

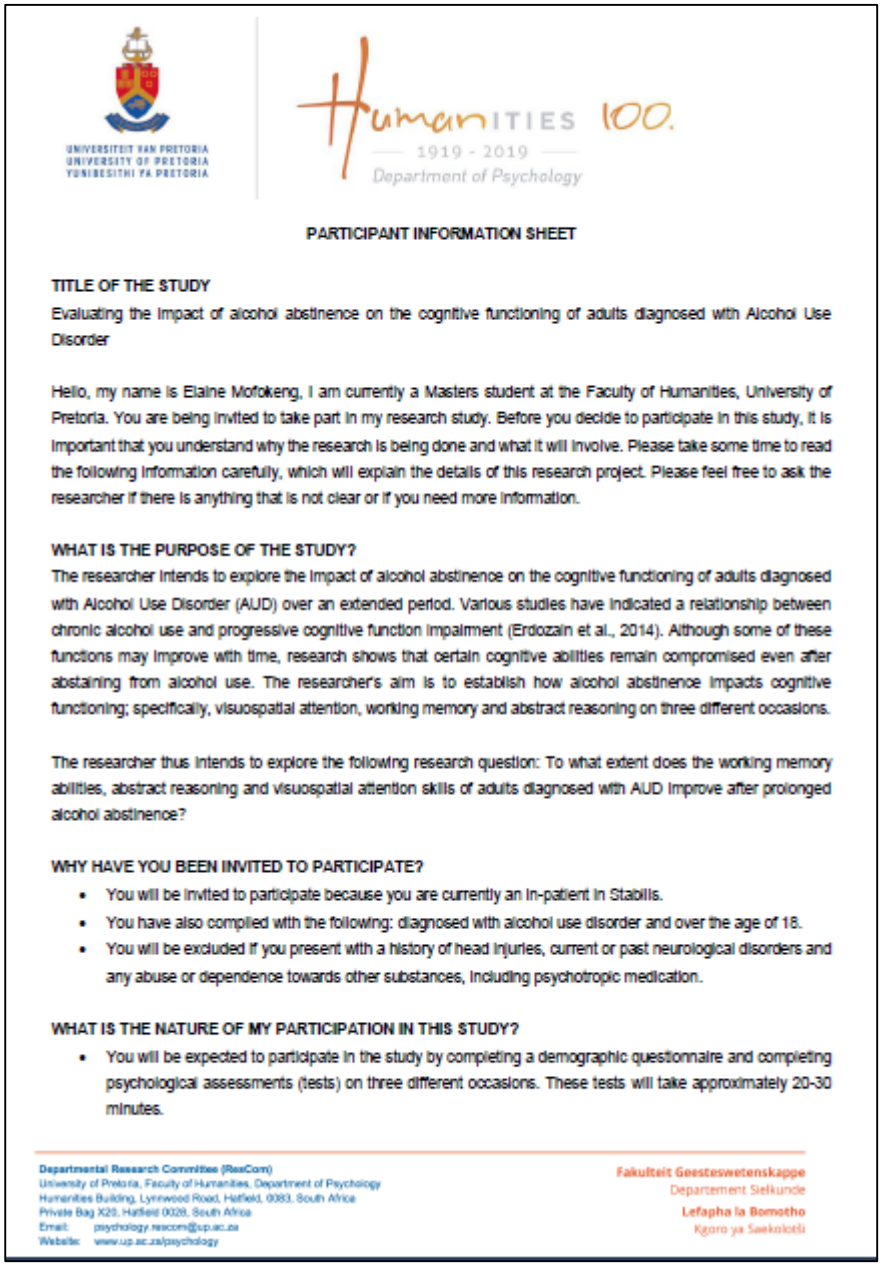
7. Do you have history of any neurological disorders? (If yes, please specify)

8. Do you have history of any psychological disorders? (If yes, please specify)

Name of Participant	Date	Signature
Name of person taking consent	Date	Signature

Page 2 of 2

Appendix 2: Participant Information Sheet



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Humanities 100.
1919 - 2019
Department of Psychology

PARTICIPANT INFORMATION SHEET

TITLE OF THE STUDY

Evaluating the impact of alcohol abstinence on the cognitive functioning of adults diagnosed with Alcohol Use Disorder

Hello, my name is Elaine Mofokeng, I am currently a Masters student at the Faculty of Humanities, University of Pretoria. You are being invited to take part in my research study. Before you decide to participate in this study, it is important that you understand why the research is being done and what it will involve. Please take some time to read the following information carefully, which will explain the details of this research project. Please feel free to ask the researcher if there is anything that is not clear or if you need more information.

WHAT IS THE PURPOSE OF THE STUDY?

The researcher intends to explore the impact of alcohol abstinence on the cognitive functioning of adults diagnosed with Alcohol Use Disorder (AUD) over an extended period. Various studies have indicated a relationship between chronic alcohol use and progressive cognitive function impairment (Erdozain et al., 2014). Although some of these functions may improve with time, research shows that certain cognitive abilities remain compromised even after abstaining from alcohol use. The researcher's aim is to establish how alcohol abstinence impacts cognitive functioning; specifically, visuospatial attention, working memory and abstract reasoning on three different occasions.

The researcher thus intends to explore the following research question: To what extent does the working memory abilities, abstract reasoning and visuospatial attention skills of adults diagnosed with AUD improve after prolonged alcohol abstinence?

WHY HAVE YOU BEEN INVITED TO PARTICIPATE?

- You will be invited to participate because you are currently an in-patient in Stabilis.
- You have also complied with the following: diagnosed with alcohol use disorder and over the age of 18.
- You will be excluded if you present with a history of head injuries, current or past neurological disorders and any abuse or dependence towards other substances, including psychotropic medication.

WHAT IS THE NATURE OF MY PARTICIPATION IN THIS STUDY?

- You will be expected to participate in the study by completing a demographic questionnaire and completing psychological assessments (tests) on three different occasions. These tests will take approximately 20-30 minutes.

Departmental Research Committee (ResCom)
University of Pretoria, Faculty of Humanities, Department of Psychology
Humanities Building, Lynnwood Road, Hatfield, 0083, South Africa
Private Bag X20, Hatfield 0028, South Africa
Email: psychology.rescom@up.ac.za
Website: www.up.ac.za/psychology

Fakulteit Geesteswetenskappe
Departement Sielkunde
Lefapha la Bomotho
Kgoro ya Saekolotši

CAN I WITHDRAW FROM THIS STUDY EVEN AFTER HAVING AGREED TO PARTICIPATE?

- Participating in this study is voluntary and you are under no obligation to consent to participation. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. You are free to withdraw at any time and without giving a reason, if you decide not to take part in the study without negative consequences or being penalized.

WILL THE INFORMATION THAT I CONVEY TO THE RESEARCHER BE KEPT CONFIDENTIAL?

- Anonymity will apply since identities are not a requirement for the study. Confidentiality will be ensured by assigning code names/numbers to each participant, and that will be used in all research notes and documents. Findings from this data will be disseminated through conferences and publications. Reporting of findings will be anonymous, only the researchers of this study will have access to the information.
- Please note participant information will be kept confidential, except in cases where the researcher is legally obliged to report incidents such as abuse and suicide risk.

WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?

- There will be no direct benefit to you for participation in this study, However, I hope that information obtained from this study will contribute to current knowledge and the aim is to guide rehabilitation centres to incorporate cognitive functioning recovery into their intervention programmes.

WHAT WILL HAPPEN IN THE UNLIKELY EVENT THAT SOME FORM OF DISCOMFORT OCCUR AS A RESULT OF TAKING PART IN THIS RESEARCH STUDY?

- Should you have the need for further discussions after the interviews or surveys an opportunity will be arranged for you at no cost.

HOW WILL THE RESEARCHER(S) PROTECT THE SECURITY OF DATA?

- Electronic information will be stored for period of 15 years. Future use of the stored data will be subject to further Research Ethics Review and approval if applicable.
- Participant information in hard copies of raw data be will locked in the cabinet and electronic data will be kept in a file that is password protected in the Department of Psychology.

WILL I BE PAID TO TAKE PART IN THIS STUDY?

- There will be no remuneration for participating in this study.

HAS THE STUDY RECEIVED ETHICS APPROVAL?

This study has not yet received written approval from the Research Ethics Committee of Faculty of Humanities, University of Pretoria.

HOW WILL I BE INFORMED OF THE FINDINGS/RESULTS OF THE RESEARCH?

- The findings of the research study will be shared with you by Elaine Mofokeng after one year of completing the study.

WHO SHOULD I CONTACT IF I HAVE CONCERN, COMPLAINT OR ANYTHING I SHOULD KNOW ABOUT THE STUDY?

If you have questions about this study or you have experienced adverse effects as a result of participating in this study, you may contact the researchers whose contact information are provided below. If you have questions regarding the rights as a research participant, or if problems arise which you do not feel you can discuss with the researchers, please contact the Research Ethics Committee of Faculty of Humanities, University of Pretoria.

Thank you for taking time to read this information sheet and in advance for participating in this study.

Researcher
Name Surname.....Elaine Mofokeng.....
Contact number.....082 573 7897.....
Email address.....elainemu@tessame.co.za...

Supervisor
Name.....Sonja Mostert.....
Contact number..... Tel +27 (0)12 420 4904.....
Email address..... sonja.mostert@up.ac.za ...

Appendix 3: Participant Consent Form

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Humanities 100.
1919 - 2019
Department of Psychology

TITLE OF THE STUDY: Evaluating the impact of alcohol abstinence on the cognitive functioning of adults diagnosed with Alcohol Use Disorder

ETHICAL APPROVAL NUMBER: HUM047/0919

WRITTEN CONSENT TO PARTICIPATE IN THIS STUDY

I, _____ (**participant name**), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation. I have also received the Participant information sheet for further information on this study.

The researcher intends to explore the impact of alcohol abstinence on cognitive functions in adults diagnosed with Alcohol Use Disorder (AUD). I understand that my participation is voluntary, and that I can withdraw from the study at any time without being penalised. I can ask to have all the information returned to me, removed from the research records or destroyed.

Participants will be expected to complete a demographic questionnaire and psychological assessments (tests) on three different occasions. These tests will take approximately 20-30 minutes and will be administered by a Psychometrist. Participants may be required to be available for a follow up interview where necessary. The rehabilitation centre will be supporting with the scheduling of times for the psychological assessments and these will take place on site.

I understand that the data collected in the study will be kept confidential, and that my identity will not be revealed to anyone but the researcher, the service provider of the assessment, the Psychometrist and the researcher's supervisor. No information about me, or provided by me during the study, will be shared or distributed without my written consent.

All records will be stored for 15 years in an electronic password protected platform at the University of Pretoria in the Humanities Building 11/22. The data will only be used for the completion of an academic Masters degree in Psychology and for future research endeavours. By signing this form, I agree to participate in the research study.

Page 1 of 2

Please complete the form below by ticking the relevant box. If you have questions or concerns about this research, please contact the researcher, Elaine Mofokeng, on 0825737897 or on email elainemu@dessame.co.za.

NO	STATEMENT	AGRREE	DISAGREE	NOT APPLICABLE
1	I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, and without any consequences or penalties.			
2	I understand that information collected during the study will not be linked to my identity and I give permission to the researchers of this study to access the information.			
3	I understand that this study has been reviewed by and received ethics clearance from Research Ethics Committee Faculty of Humanities of the University of Pretoria.			
4	I understand who will have access to personal information and how the information will be stored with a clear understanding that I will not be linked to the information in any way.			
5	I understand how this study will be written up and published.			
6	I understand how to raise a concern or make a complaint.	NOTE: STATEMENTS 7 TO 11 NOT APPLICABLE SINCE THEY ARE NOT RELEVANT TO THE STUDY.		
7	I consent to being audio recorded.			
8	I consent to being video recorded.			
9	I consent to having my photo taken.			
10	I consent to have my audio recordings /videos / photos be used in research outputs such as publication of articles, thesis and conferences as long as my identity is protected.			
11	I give permission to be quoted directly in the research publication whilst remaining anonymous.			
12	I have opportunity to ask questions and I agree to take part in the above study.			

Name of Participant Date Signature

Name of person taking consent Date Signature

Appendix 4: Centre Consent Document

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Faculty of Humanities

Letter of Introduction and Informed Consent
Department of Psychology

Title of the study
Evaluating the impact of alcohol abstinence on the cognitive functioning of adults diagnosed with Alcohol Use Disorder.

Researcher details:
Ms Elaine Mofokeng (19297204)
Cell: 082 573 7897/066 3000 756
Email: elainemj@tessama.co.za

10 September 2019

To Dr van der Merwe,

I am a student from the Department of Psychology at the University of Pretoria. I am currently busy with the research study titled "Evaluating the impact of alcohol abstinence on the cognitive functioning of adults diagnosed with Alcohol Use Disorder". In order to do this, I require access to 30 patients diagnosed with AUD attending treatment at a rehabilitation centre. Research summary:

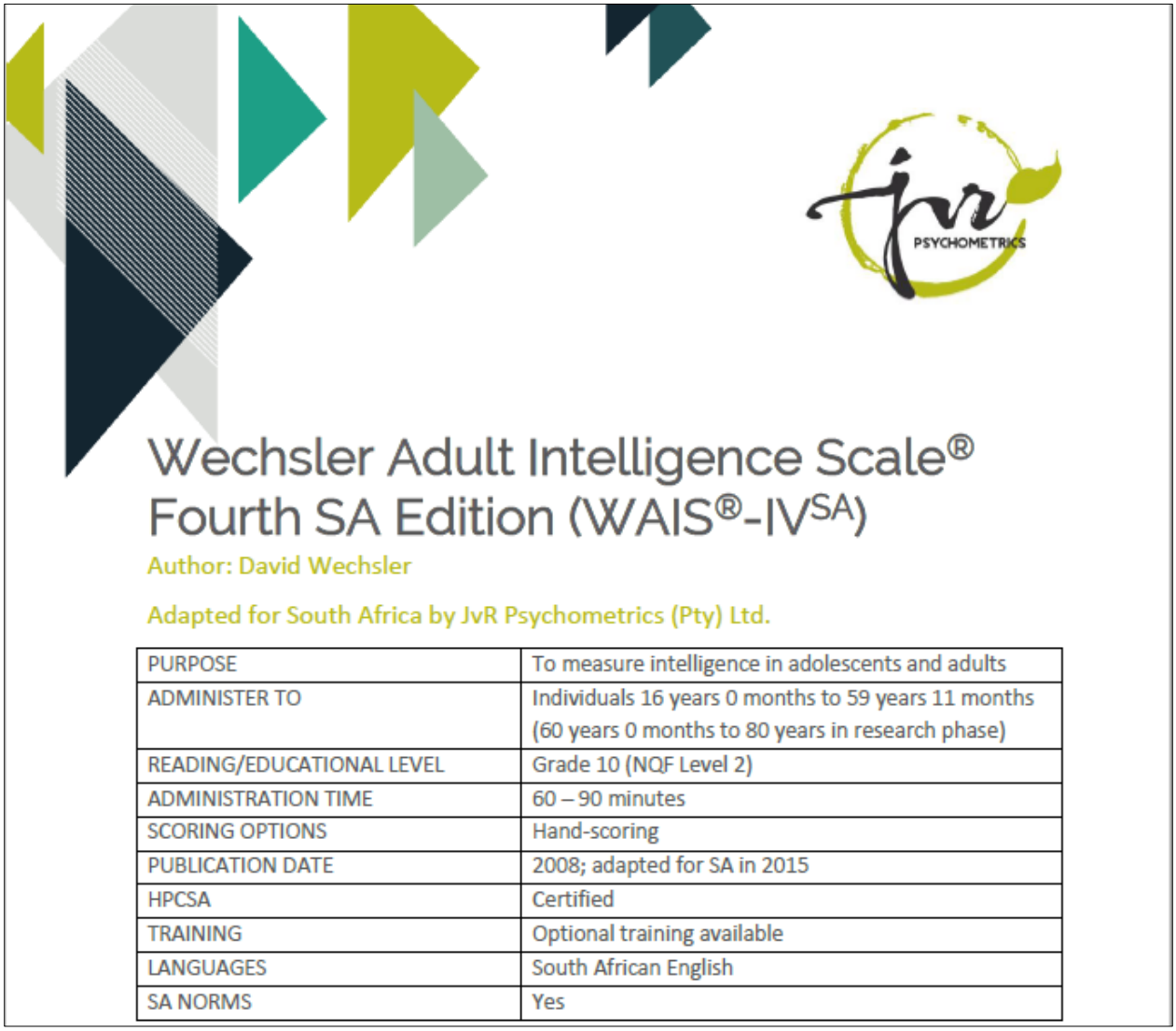
- The researcher intends to explore the impact of alcohol abstinence on the following cognitive functions in adults diagnosed with Alcohol Use Disorder (AUD): visuospatial attention, working memory and abstract reasoning on three different occasions.
- The assessment of these cognitive functioning will be done upon admission, a day before discharge and 30 days after discharge using the WAIS-IV tool.
- The data will be analysed with a factorial ANOVA with repeated measurements on one factor.
- The data collected in the study will be kept confidential, and the identity of patients will not be revealed to anyone but the researcher, the service provider of the assessment, the psychologist at Stabilis and the researcher's supervisor.
- The patients may stop participating at any time without any negative consequences.
- The data will only be used for the completion of an academic Masters degree in Psychology and for future research endeavours. The centre will receive a summary of the study upon request.
- Patient participant is **voluntary,** and they will be required to complete a demographic questionnaire to better understand certain background information about them.

If consent is granted, please may you sign this form. By signing you would be granting consent that your organisation is willing to voluntarily participate in the study.

Signature	Designated Role	Date
	EXECUTIVE DIRECTOR	11-09-2019

Stabilis Treatment Centre
Practice Nr. 0043494
P O Box 32727
Waverley 0135
Tel: (012) 333 7702

Appendix 5: Summary of WAIS-IV^{SA}



PURPOSE	To measure intelligence in adolescents and adults
ADMINISTER TO	Individuals 16 years 0 months to 59 years 11 months (60 years 0 months to 80 years in research phase)
READING/EDUCATIONAL LEVEL	Grade 10 (NQF Level 2)
ADMINISTRATION TIME	60 – 90 minutes
SCORING OPTIONS	Hand-scoring
PUBLICATION DATE	2008; adapted for SA in 2015
HPCSA	Certified
TRAINING	Optional training available
LANGUAGES	South African English
SA NORMS	Yes

Source: Wechsler, D. (2014). *Wechsler Adult Intelligence Scale: Fourth South African edition* (WAIS-IV^{SA}). Johannesburg, South Africa: JvR Psychometrics (Pty) Ltd.

Appendix 6: Proof of Editing

INSIGHTFUL EDITORIAL

TO WHOM IT MAY CONCERN

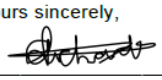
This is to certify that the dissertation written by Erengai Elaine Mofokeng and entitled:

Evaluating the Impact of Alcohol Abstinence on the Cognitive Functioning of Adults Diagnosed With Alcohol Use Disorder

was copy edited for grammar, spelling, punctuation, academic style, and professional layout (including numbering, pagination and heading format) by the undersigned. At the same time, a reconciliation of citations and the accompanying Reference List was undertaken. The writer was provided with the corrections/amendments which required action.

The undersigned takes no responsibility for corrections/amendments not carried out in the final copy submitted for examination purposes.

Yours sincerely,



Carla Richards (Educational Psychologist)

Insightful Editorial

carla@insightfuleditorial.com

www.insightfuleditorial.com