An evaluation of the cognitive functioning of individuals on Methadone Maintenance Treatment and its relation to treatment adherence

A thesis submitted in partial fulfilment
of the requirements for the degree of
Doctor of Philosophy in Psychology
at the University of Waikato

by

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2009

ABSTRACT

This research assessed the cognitive functioning of several different drug and alcohol samples, with a specific focus on individuals in methadone maintenance treatment. Additionally, this research assessed the relation between cognitive functioning and adherence to treatment in these populations. This is a link that has been suggested by research in this area previously. The present research consisted of five experiments. Experiment 1 assessed the application, within New Zealand, of the normative data for a number of psychometric tests with a non- substance using sample of New Zealand university students. The results from this study showed that the scores for the university sample were generally similar to the normative means, suggesting that the existing normative data could be used in New Zealand. Experiment 2 assessed the cognitive functioning of university students who reported regular use of alcohol and/or cannabis. The results from this study showed that the frequency of alcohol use was positively correlated with problem solving ability, while frequency of cannabis use was positively correlated with memory functioning. Cannabis use was also associated with poorer problem solving ability. These findings showed that casual use of alcohol and/or cannabis was associated with poorer functioning on some psychometric tests, and that these tests were sensitive to the effects of substance use. Experiment 3 assessed the cognitive functioning of a sample of individuals in methadone maintenance treatment in relation to their adherence to treatment. The results from this study showed deficits in memory, divided attention and cognitive flexibility, and poor mathematical ability when compared to the normative data. Treatment adherence was found to be associated with lower levels of treatment satisfaction, and findings also suggested a possible relation between poor treatment adherence and better scores on the psychometric test scores. Due to difficulties in recruiting participants, Experiment 4 assessed the cognitive functioning of a second sample of individuals in methadone maintenance in relation to treatment adherence. This sample completed a reduced battery of psychometric tests, and results showed deficits in memory, attention, and problem solving abilities compared to the normative data. Treatment adherence was not found to be associated with lower levels of treatment satisfaction in this sample. A possible relation between poor treatment adherence and better psychometric test scores was identified for this sample also,

although the relation was between different test scores than those in Experiment 3. To assess whether the obtained results for Experiment 3 and Experiment 4 were specific to methadone, Experiment 5 assessed the cognitive functioning of several different drug and alcohol samples in relation to treatment adherence. The study examined the cognitive functioning of alcohol, drug and alcohol, and other opiate users, and showed that all samples had difficulty recalling information in a visual format, that a large percentage showed impairments in divided attention and cognitive flexibility, and that the drug and alcohol, and other opiate samples had deficits in problem solving ability. Treatment adherence in this study was assessed for the alcohol sample, with results showing a relation between poor treatment adherence and verbal memory ability, and divided attention and cognitive flexibility. Overall, the cognitive deficits found in the samples for each experiment were not related to treatment adherence as measured in this research. However, results for the alcohol sample suggested that there may be a link between poor adherence and impairments in verbal memory and divided attention. The findings from this research suggest that cognitive deficits and treatment adherence are not related, but this finding may be the result of limitations in this research (i.e., recruitment difficulties, adherence measures used). The clinical and research implications of the results of the research are discussed. In particular, recommendations for treatment services dealing with the drug and alcohol population are provided.

ACKNOWLEDGEMENTS

It is with the greatest joy that I write this page, as it means that this thesis is finally submitted! While this process has not been easy, there are a number of people that have helped me through this process that I feel the need to thank.

To those individuals who participated in this research, and gave so freely of their time, I thank you from the bottom of my heart. Your stories have opened my eyes to what it means to be addicted to a substance that affects your life so greatly. I hope that that this research provided further insight for each of you, and highlights the needs of people attending drug and alcohol services in general.

To my parents who have supported me through so many years of study, and to my siblings who have also been there for me through that process. I can never thank you enough for everything that you have done for me, and I hope that I can begin to repay my debt over the coming years.

To my partner Conor who has put up with so much over the years, and who has been secretly (or not so secretly) praying that I would finish my studies – it has finally happened!

To my supervisors, Mary Foster and Nicola Starkey who have supported me and pushed me in the right direction, I am sincerely thankful. Without your support I would not have achieved this, and while I may not have always appreciated it at the time, I thank-you for your feedback and comments that helped me to better understand why I was doing this research.

I would like to thank my friends and colleagues who have supported me through this process. I will miss the discussions we have had about the long and sometimes painful process of doing a PhD, and also the conversations that have discussed life, the universe, and everything in between.

Of all my colleagues, I wish to thank Jennifer particularly. You have spent many hours attempting to keep me sane throughout this process, and you may be one of the few people that truly understand what it is to be a PhD student and the neuroticism this entails.

And to all of those still completing a PhD, or to those who contemplate it in the future, I wish you all the best. May you all remain sane despite the curveballs that your thesis throws at you.

TABLE OF CONTENTS

LIST OF TABLES

APPENDICES

INTRODUCTION

The cost of both licit and illicit substance use is high. Estimates from England place the societal cost from illicit substance use alone at over £11,000 per head of population per year (equivalent to NZ$19,719 per person), which is mainly attributable to criminal behaviour (Healey, Knapp, Astin, Gossop, Marsden, Stewart, Lehmann, & Godfrey, 1998). Within New Zealand, sources estimate the value of the New Zealand illicit drug market as being between $340 million (Nippert, 2005) and $1 billion per year (Anonymous, 2005b). While this is substantially lower that that seen in many overseas countries (Bramley-Harker, 2001; Caulkins & Reuter, 1998), substance use is still a serious concern within New Zealand.

In addition to the cost to society, the cost for the individuals themselves is hard to estimate as this cost incorporates many factors. These include: financial expenditure; health consequences; the impact on family/friends; loss of productivity from job absenteeism; lost employment; and premature death to name but a few. However, while the societal and personal costs of substance use are high, the services that are provided to reduce these costs often have poor attendance rates, and it is common for individuals seeking treatment to have several treatment episodes during their lifetimes (National Institute on Drug Abuse, 1999; Substance Abuse and Mental Health Services Administration Office of Applied Studies, 2007). The reasons for poor attendance at such services are varied, however recent research has suggested that poor attendance could be a result of cognitive impairments in this population (e.g. Aharonovich, Nunes, & Hasin, 2003; Fals-Stewart, 1993; Fals-Stewart & Lucente, 1994; Fals-Stewart & Schafer, 1992; Fals-Stewart, Schafer, Lucente, Rustine, & Brown, 1994; Teichner, Horner, Roitzsch, Herron, & Thevos, 2002; Verdejo-Garcia, Lopez-Torrecillas, Orozco, & Perez-Garia, 2004).

Substance Use Overseas and in New Zealand

Overseas research has suggested that up to 25% of individuals seen in primary care clinics (e.g. general practices) have an alcohol or drug disorder (Jones, Knutson, & Haines, 2003; Sullivan & Fleming, 1997). Additionally, over 50% of adolescents in the United States are likely to have experimented with illicit substances by the time

they graduate from high school (Gordon, Kinlock, & Battjes, 2004). While the majority do not continue to use substances, substance use prior to the age of 15 has been linked to problems with alcohol, tobacco and other substances in later life.

Within New Zealand, the rates of illicit substance use per head of population appear to be similar to those seen in Australia and the United States (Black & Casswell, 1993), however, the substances that are available in New Zealand differ to those available in other countries due to the isolated nature of the country. A nationwide survey conducted between 1998 and 2001 (Wilkins, Casswell, Bhatta, & Pledger, 2002) reported rates of cannabis use (54%), and other illicit substances (4% opiates, 15% hallucinogens, 11.9% stimulants) in a sample of individuals aged 15-45, with greatest rates found for individuals aged 18-24 years (almost 60% having used illicit substances at least once). Of this sample, 12.5% met the criteria for cannabis dependence, and 3.6% for other illicit substance dependence by the age of 25 years (equivalent to almost one in seven individuals). Similarly, a longitudinal study in Christchurch (Boden, Fergusson, & Horwood, 2006) reported that 76.1% of the individuals in their sample had tried cannabis and 43.5% had used other illicit substance on at least one occasion by the age of 25 years. The estimated prevalence rates of substance use disorders in New Zealand are higher than many overseas countries (with the exception of Australia), with 3.5% of the population having a substance use disorder in any 12 month period (Wells, Oakley Browne, Scott, McGee, Baxter, & Kokaua, 2006). Greatest prevalence rates were noted for the 16-24 year (9.6%) and 25-44 year (4.2%) samples, which suggests that a greater percentage of New Zealanders develop substance use disorders over their lifetimes.

In addition to the societal cost of alcohol and drug use, there are a number of risk factors associated with the use of substances, in regards to both the method of substance use, and the impacts of substance use on an individual's health. Prolonged use can have long-term impacts on an individuals health, with organ damage and cancer of particular concern (Iversen, 2001; NZPA, 2005). The manufacture of substances may also have detrimental effects on the individual's health in other ways. For example, the manufacture of substances such as methamphetamine in clandestine labs produce a number of dangerous & poisonous chemicals that are harmful if inhaled, and also have a high risk of combustion, fire and explosion (Dann, 2005).

Substance use has also been linked to detrimental effects on brain functioning, however, the long term effects of substance use on the brain are still unclear. While

there is no definitive answer regarding the effects of substance use on brain functioning, research is increasingly suggesting that while there may be some recovery following abstinence, this recovery may be limited (Verdejo-Garcia, Lopez-Torrecillas, Orozco, & Perez-Garia, 2004). Impairments in functioning, either as a precursor to, or as a result of substance use, are increasingly being studied as this is an area that could be targeted with the aim of improving treatment programmes, and educating individuals about the harm of substance use.

Given the number of potential health related issues and impairments in daily functioning that individuals may experience, due to their substance use, many individuals will eventually seek treatment, or may be mandated to by legal authorities. However, the success rates of treatment programmes vary substantially. A number of the available treatment approaches in the alcohol and drug field are outlined below.

Treatment Approaches to Alcohol and Drug Use

In New Zealand there are over 100 agencies that specialise in alcohol and drug treatment, with most services catering to both drug and alcohol populations. As at 2005, the government contributed $72 million towards these alcohol and drug services (Anonymous, 2005a). Research has suggested that the majority of clients in these services are male (60%), and approximately 28% are Maori (Adamson, Sellman, Futterman-Collier, Huriwai, Deering, Todd, & Robertson, 2000). The most common reasons for seeking treatment are alcohol related issues (45%), cannabis use (27%), and opioid use (17%). These services use a wide variety of approaches to the treatment of alcohol and drug related problems ranging from the well know 12 step programmes and abstinence based treatment through to the, more recently developed, harm reduction approach. For a more detailed review of drug and alcohol treatment services see Gossop (2006) and Raistrick, Heather and Godfrey (2006).

Of particular interest in this research were the treatment services available for opiate users. At the present time, the only substitution treatment option for opiate dependence that is available in New Zealand is Methadone Maintenance Treatment (MMT). Further details on MMT are provided in the following section.

Treatment Services for Opiate Users

MMT has long been provided as a treatment option for heroin dependence, although it is also used for other opiate use diagnoses with equal success. Within New

Zealand, this includes individuals who have been using substances such as temgesic, morphine sulphate tablets (MST), poppy extract morphine, methadone tablets, homebake, pethidine and palfium (Thornton, 1991). MMT is the most popular treatment option for opiate dependence, with overseas research suggesting that approximately 42.6% of individuals in treatment for drug dependence are enrolled in a MMT programme (Gossop, Marsden, & Stewart, 1998). Despite the high percentage of opioid dependent individuals in alcohol and drug treatment in general, overseas estimates suggest that only 15% – 25% of opioid users are in treatment at any given time, and that long-term treatment programmes have trouble retaining individuals (Rosenblum, Magura, & Joseph, 1991).

The main objective of MMT is to improve the health of opiate users by minimising the harm associated with opiate use, in order for these individuals to maintain some stability in their daily lives. Over 500 studies have demonstrated the effectiveness of MMT in achieving these aims (Bryne & Newman, 1999; Ward, Mattick, & Hall, 1998).

MMT programmes have been shown to decrease the risks associated with opiate use. Reductions in mortality, overdoses, and substance related health problems have been reported in MMT populations when compared to individuals who continue with illicit use (e.g. Collins, Hubbard, & Valley Rachal, 1985; Desmond & Maddux, 2000; Digiusto, Shakeshaft, Ritter, O'Brien, Mattick, & NEPOD Research Group, 2004; Gronbladh, Ohlund, & Gunne, 1990; Hall, Lynskey, & Degenhardt, 2000; Hickman, Madden, Henry, Baker, Wallace, Wakefield, Stimson, & Elliott, 2003; Milroy & Forrest, 2000; Rosinger, Finkbeiner, Krings, & Gastpar, 1998; Sheerin, Green, Sellman, Adamson, & Deering, 2004; Sung-Yeon, 1993; Warner-Smith, Lynskey, Darke, & Hall, 2001). MMT has also been linked to improved employment status, reduction in illicit drug use of all types, reduction in criminal behaviour, and overall improvement in quality of life (Latowsky & Kallen, 1997). Long-term maintenance on MMT has been associated with continued improvements in functioning (Kandel, Huang, & Davies, 2001).

The overall costs to society additionally appear to decrease for those on MMT. For example, in 1996 the estimated cost per annum for an individual on MMT in New Zealand was $4,400 compared to the estimated $50,000 for an opioid dependent individual in the correctional system (Sellman, Hannifin, Deering, & Borren, 1996). Such comparisons in terms of cost are made as the current rate of opioid use in New

Zealand prisoners is estimated to be at least 10-20 times higher than the general population (Sellman, Hannifin, Deering, & Borren, 1996).

Methadone Maintenance in New Zealand

In 2003, it was estimated that between 13,500 and 26,000 New Zealanders were addicted to opiates, with a predicted increase of 15% per year (Fleming, 2003). To cater for this population, approximately 4000 individual MMT places are funded by the New Zealand Government (Sell & Zador, 2004). The cost of providing this treatment is estimated at $4,400 per annum per individual (Sellman, Hannifin, Deering, & Borren, 1996; Sheerin, Green, Sellman, Adamson, & Deering, 2004).

In general, New Zealand MMT programmes adhere to a harm reduction rather than an abstinence based philosophy. Essentially, this means that methadone is prescribed with the aim of reducing the harm/risks associated with illegal use of opioids (e.g. HIV, hepatitis, unsafe injecting practices, and overdose). This is not to say that illegal use is condoned, although this approach generally allows for the use of some illegal substances while maintaining the individual's safety.

While methadone maintenance has been shown to be effective in reducing the risks associated with illicit opiate use, attendance and adherence at drug and alcohol services is poor. For example, it is estimated that of the appointments scheduled with MMT population at the Community Alcohol and Drug Service in Hamilton, approximately 66% of appointments are attended (Barratt, personal communication, 2004). Possible reasons for the poor retention and adherence to treatment are outlined below.

Retention and Adherence

Literature in the drug and alcohol field has focused on the relationship between demographic factors and treatment outcomes for a number of years. Primarily, studies have attempted to determine the reasons why some people stay in treatment while others drop out. Studies have looked at several areas, including the retention, and adherence of individuals in treatment, however, although retention and adherence can be classified as distinctly different areas of treatment outcome, the terms are often used interchangeably.

Retention

Drop-outs and poor retention have been identified as a major limitation of substance abuse/dependence treatments. Retention in treatment, typically defined as remaining in the treatment programme (Esteban, Gimeno, Barril, Aragones, Climent, & de la Cruz Pellin, 2003; Fals-Stewart & Lucente, 1994), has been of particular interest as retention rates have been repeatedly shown to be the worst in the first few weeks and months of drug and alcohol treatment.

MMT retention rates, in particular, have generally been lower than those seen for treatment programmes that target other substances, although the retention rates reported in different studies vary greatly. Overseas research and service reviews suggest that retention and adherence rates in MMT are between 10% and 88% (e.g. Babst, Chambers, & Warner, 1971; Craig, 1980; D'Ippoliti, Davoli, Perucci, Pasqualini, & Bargagli, 1998; Del Rio, Mino, & Perneger, 1997; Dore, Walker, Paice, & Clarkson, 1999; Esteban et al., 2003; Gossop, Marsden, Stewart, Edwards, Lehmann, Wilson, & Seger, 1997; Gutierrez, Ballesteros, Gonzalez-Oliveros, & Ruiz de Apodaka, 1995; Maremmani, Zolesi, Aglietti, Marini, Tagliamonte, Shinderman, & Maxwell, 2000; Saxon, Wells, Fleming, Jackson, & Calsyn, 1996; Torrens, Castillo, & Perez-Sola, 1996). Within New Zealand, retention rates may vary from those seen overseas, although little research has been conducted in this area. Dore, Walker, Paice and Clarkson (1999), in the first New Zealand study of MMT individuals, reported a high retention rate with 86% remaining on the programme for 6 months or longer.

Research has suggested that the poor retention rates seen in drug and alcohol populations, and MMT populations specifically, may be related to treatment or treatment population characteristics. For example, several research studies have reported a relationship between methadone dose and outcome, with higher doses generally predictive of better treatment attendance and retention (Borg, Broe, Ho, & Kreek, 1999; D'Ippoliti, Davoli, Perucci, Pasqualini, & Bargagli, 1998; Farre, Mas, Torrens, Moreno, & Cami, 2002; Maxwell & Shinderman, 2002; Strain, Stitzer, Liebson, & Bigelow, 1993; Torrens, Castillo, & Perez-Sola, 1996). However, others have found no relationship between methadone dose and treatment retention (Blaney & Craig, 1999; Del Rio, Mino, & Perneger, 1997).

Other factors that have been associated with retention include: length and severity of drug use (Babst, Chambers, & Warner, 1971; Del Rio, Mino, & Perneger,

1997); counselling attendance, and opiate abstinence at 2 weeks (Morral, Belding, & Iguchi, 1999); and free treatment, greater contact with treatment, and increased rating of client cooperation by staff (Booth, Corsi, & Mikulich-Gilbertson, 2004). Drop-out, or failure to remain in treatment, has been associated with increased alcohol dependence, cocaine dependence, decreased legal status, increased number of previous treatment episodes, and increased number of psychiatric problems (Simpson, Joe, Broome, Hiller, Knight, & Rowan-Szal, 1997). However, other studies have found no relationship between retention and cannabis use (Epstein & Preston, 2003).

With retention rates in drug and alcohol services lower than many funding agencies would like, the possible reasons for poor retention have been examined in relation to adherence to treatment. The aim of assessing these factors is to identify those individuals who are more or less likely to succeed in treatment so that services can be tailored to the needs of this population.

Adherence

Adherence is defined by the American Heritage Stedman's Medical Dictionary (2002) as “the extent to which the patient continues the agreed-upon mode of treatment under limited supervision when faced with conflicting demands, as distinguished from compliance or maintenance”. Adherence has, however, often been interchangeably defined as compliance “The degree of constancy and accuracy with which a patient follows a prescribed regimen, as distinguished from adherence or maintenance” (Editors of the American Heritage Dictionaries, 2002). In the interests of this review both adherence and compliance have been reviewed, and defined as adherence.

Research has focused on adherence in an attempt to outline the characteristics of individuals who do well in treatment (Gilmore, Lash, Foster, & Blosser, 2001). More recently, research has suggested that adherence rates are similar across substance disorders which may aid us in understanding the reasons for the different levels of adherence (Morrison, 2004).

Adherence criteria in drug and alcohol populations have been based on a number of factors as outlined in Table 0.1. The criteria used to assess adherence, as shown in Table 0.1, have varied greatly with no preferential approach to assessment evident in this area. Reviews of the literature on adherence suggest that poor adherence is associated with lower levels of education, (Kalichman, Ramachandran,

& Catz, 1999; Sofuoglu, Gonzalez, Poling, & Kosten, 2003), being from an ethnic minority (Agosti, Nunes, & Ocepeck-Wellkson, 1996); psychiatric comorbidity (e.g. Alterman, McDermont, Cacciola, Rutherford, Boardman, McKay, & Cook, 1998; Cacciola, Alterman, Rutherford, McKay, & Mulvaney, 2001; Caplehorn, Reilly, & Wodak, 1993; Fals-Stewart & Lucente, 1994; Grella, 1997; McLellan, Alterman, Metzger, Grissom, Woody, Luborsky, & O'Brien, 1994; Messina, Farabee, & Rawson, 2003; Ross, Dermatis, Levounis, & Galanter, 2003; Weiss, 2004), and unemployment (Mutasa, 2001). Positive correlations have been found between adherence and motivation to seek treatment, social stability, previous treatment

Table 0.1

Example of Treatment Adherence measures used

Study	Measure/s used
(Ferrando, 1996)	Mean change in biological markers in urinalysis results Mean percentage of drug positive urinalysis results
(Gilmore et al., 2001)	Mean number of days in treatment Completing 28 days of treatment Mean comprehension rating Mean motivation rating Mean participation rating Beginning aftercare group therapy Mean number attended after care groups Readmittance at 3 months Readmittance at 6 months
(Golin et al., 2002)	Composite score from electronic medication bottle caps, pill count and self-report
(Morrison, 2004)	Electronic monitoring Prescription filling Continuation in clinical studies Percentage of patients discontinuing medication Proportion of days on which treatment medication is taken
(Saxon et al., 1996)	Illicit substance use as reflected by urinalysis results
(Weiss, 2004)	Patient interviews Collateral reports Rates of prescription refill Pill counts Serum or urine drug level monitoring Urinary medication markers Electronic event system monitoring systems Daily diaries

(Simpson & Joe, 1993), alcohol related diagnoses (Veach, Remley, Kippers, & Sorg, 2000); and in opiate treatment higher use of Buprenorphine (a substitute treatment for opioid use), lower levels of pre-treatment use prior to admission and lower doses of methadone while in treatment (Tremeau, Darreye, Khidichian, Weibel, Kempf, Greth, Schneider, Wantz, Weber, Stepien, & Macher, 2002). In particular, individuals seeking treatment for cocaine and opiate use have higher rates of non-adherence than other substance using individuals (Agosti, Nunes, & Ocepeck-Wellkson, 1996; Grella, 1997).

In relation to MMT specifically, research has identified a number of factors that may be predictive of treatment adherence. Poor adherence has been associated with a lack of choice in treatment options (Bell, Digiusto, & Byth, 1992), conflicts between treatment goals and the norms and values of the substance using population (Rosenblum, Magura, & Joseph, 1991), and poor treatment satisfaction (National Treatment Agency for Substance Misuse, 2007; Simpson, Joe, & Brown, 1997; Villafranca, McKellar, Trafton, & Humphreys, 2005). Additionally, it has been suggested that it is more difficult to maintain polysubstance users in MMT as, while methadone helps to treat opioid dependence, the use of other drugs or alcohol may interfere with an individuals ability to adhere to treatment protocols/policies (Babst, Chambers, & Warner, 1971).

As can be seen, previous research has shown that there are number of possible predictors of adherence and retention. However, no one factor has been singled out as more predictive of adherence and retention across studies. A possible reason for the inconsistent findings in the research on adherence and retention, are the limitations associated with many of the studies. The major limitation is the variation in the measures and definitions used across studies. For example completion of treatment may refer to discharge based on meeting service based treatment goals, based on clients perception of goals achieved and therefore leaving treatment, or completion of time limited treatment program irrespective of current dependence; while drop-out can include those expelled due to poor cooperation or poor compliance, poor treatment attitude, client choice, poor treatment satisfaction, unsuitability of client or program, or lack of motivation (Lewis & Ross, 1994). Studies have also been limited by failing to deal with complex relationships among variables such as individual characteristics and program goals; differences in programs (i.e. harm reduction versus abstinence based, fee versus free, inpatient versus outpatient, medical versus

therapeutic models, qualifications of staff running program); differences in ways in which treatment approaches are applied; lack of control samples; issues with recruitment or sample selection; differences in follow-up procedures; issues with self-report measures; changes in treatment approaches over time; small sample sizes; poor definitions of what treatment involves, what is required for adherence and retention, what constitutes 'success' in programs; under what circumstances individuals leave programs; and how regularly reviews are conducted to check individuals are complying with treatment, to name but a few of the factors (Condelli, 1994; Gowing, 2001; Lewis & Ross, 1994).

More recent studies, such as Peles, Schreider and Adelson (2006) have begun to use large sample sizes to address issues of power, however limitations still exist. In this research the treatment requirements (regular personal therapist appointments, therapy groups, daily dosing, take-home doses (up to 14) dependent on no drug use) were very specific to the treatment service which makes comparison to other studies difficult; treatment was fee based which may have affected participant engagement (i.e. more likely to engage due to cost paid/more likely to drop out as not affordable over time); may not be applicable to female users (almost 73% of participants were male); no information was provided about how retention was assessed (appears to have been based on those who remained in treatment but it is unclear over what time period) and under what circumstances individuals were not retained in treatment (I.e. they dropped out, they completed treatment, they were discharged for failing to following treatment protocols). Bell, Burrell, Indig and Gilmour (2006) in an Australian study, analysing predictors of retention in treatment in three cohorts in New South Wales over 10 year period, addressed many of the failings of previous studies. This study included a large sample size, across several treatment settings, differences in treatment approaches over time, differences in free versus fee treatment program, and reasons for drop-out. Even with such intensively designed research, limitations however still exist, such as limited information routinely collected for clients, differences in what 'successful treatment' means across treatment settings, differences in treatment modalities (i.e. abstinence based or harm reduction based), and no information on the effects of methadone dose on results. However, such studies are a step in the right direction, make generalization to the wider population more applicable, and may begin to address the inconsistencies previously seen in the literature.

As discussed above, there are a number of possible reasons why literature to date has been inconsistent in this area, such as the ways in which adherence and retention have been assessed, however it may also be due to the number of cognitive skills that are required to adhere to treatment. For example, individual skills needed to comply with treatment, such as attending weekly appointments, complying with treatment rules, and social interaction skills may be impaired in this group thus leading to poor adherence rates (Kleber, Weiss, Anton, Rounsaville, George, Strain, Greenfield, Ziedonis, Kosten, Hennesey, O'Brien, Smith Connery, McIntyre, Charles, Anzia, Nininger, Cook, Summergrad, Finnerty, Woods, Johnson, Yager, Pyles, Cross, Walker, Peele, Barnovitz, Hafler Gray, Shemo, Saxena, Tonnu, Kunkle, Albert, Fochtmann, Hart, & Regier, 2006; Weinstein & Shaffer, 1993). The majority of treatment approaches also include cognitive components that require attention and conceptual understanding which may be impaired. Recent research into this area has suggested that cognitive deficits may be a causal factor in poor adherence and retention as a number of studies have identified greater levels of cognitive impairment in drug and alcohol populations than in the general population.

Cognitive impairments have been associated with shorter treatment length, poorer programme participation, more frequent rule violations, more frequent removal from treatment (Fals-Stewart & Lucente, 1994), early drop-out from treatment (Teichner, Horner, Roitzsch, Herron, & Thevos, 2002; Woods, Freitas, & Fas-Stewart, 1999), higher relapse rates (Miller, 1991), continued substance use (Blume, Schmalinga, & Marlatt, 2005), and less treatment success (Cooney, Kadden, Litt, & Getter, 1991).

Given that a number of the factors and characteristics outlined as predictive of retention and adherence in treatment could be a result of underlying cognitive impairment or difficulty, for example impulse control and decision making, further research is needed to better understand what, if any, cognitive impairments this population is likely to present with, and how these impairments might affect treatment outcomes. Previous research has suggested that impairments in cognitive functioning are likely to result in increased rule violations, difficulty maintaining abstinence, difficulty achieving treatment goals, and poorer clinical estimates and outcomes (e.g. Aharonovich, Nunes, & Hasin, 2003; Fals-Stewart, 1993; Fals-Stewart & Lucente, 1994; Fals-Stewart & Schafer, 1992; Fals-Stewart, Schafer, Lucente, Rustine, &

Brown, 1994; Teichner, Horner, Roitzsch, Herron, & Thevos, 2002; Verdejo-Garcia, Lopez-Torrecillas, Orozco, & Perez-Garia, 2004).

Relation between adherence, retention and cognitive functioning

In order to assess how cognitive impairments may impact on MMT treatment in New Zealand, the cognitive skills that are needed by individuals enrolling in, and already on the MMT programme at CADS in Hamilton were assessed.

In most cases, MMT requirements differ from those which individuals have experienced previously (e.g. picking up doses daily, not receiving a "high" from methadone as it is a long acting opiate – 24-36 hours, limitations on substance and alcohol use). Individuals that are new to the MMT programme are faced with a number of changes in their daily lives, including having to organise holidays/travel well in advance, the possible side effects of methadone, the interaction of methadone with other substances and/or prescription medications, and the effects of methadone on present medical conditions. Adapting to these changes requires a large number of skills, some of which consumers may not have needed previously. Therefore, underdevelopment of these skills may have an effect on the success of the treatment.

The MMT programme provided by CADS Hamilton requires individuals to attend appointments when scheduled, and pick up their methadone dose daily. In addition, individuals are expected to demonstrate stability in other areas of their lives, which encompass cognitive skills associated with daily living to be eligible for 'takeaway' doses. As individuals on MMT can choose, to a certain extent, how much interaction they have with CADS Hamilton, only those skills that are needed to comply with the minimum requirements (those skills absolutely necessary) are discussed here.

In order for individuals to pick-up there methadone on a daily basis, it is expected that they will:

1) Be told that they need to pick up their methadone daily from a specific pharmacy, which requires listening and attention skills;
2) Remember that they are expected to pick up their methadone daily which requires short and long term memory, and recall skills (although these skills may be superseded by opioid withdrawal);

3) Be expected to attend the pharmacy during opening hours on a daily basis, which requires additional planning and problem solving skills.

Additionally, there are a number of steps involved with regard to appointment attendance. Firstly, consumers must be told about the appointment, which means they must be able to attend and listen. Once having been told of the appointment, it is expected that the consumer will:

1) Comprehend the need to attend the scheduled appointment, which indicates a need for insight, reasoning and judgement skills;
2) Remember that they have an appointment, which requires short and long-term verbal and/or visual memory depending on the methods used to remember, and later recall the appointment;
3) Be able to form an association between the scheduled appointment and the date, which requires working memory skills; and
4) Attend the appointment on time and at the correct location, requiring additional planning and problem solving skills.

Over time, consumers are expected to reduce their illicit drug use or face possible discharge from the methadone programme. It is expected, therefore, that consumers will, at a minimum, be able to manage impulsiveness, and also have skills associated with problem solving skills when faced with a situation which they have associated with prior opiate use. While reducing their illicit drug use, consumers are expected to follow guidelines regarding non-intoxication at appointments and when picking up methadone. This requires additional problem solving and planning skills, as well as the, previously mentioned, ability to control impulsiveness.

In addition, consumers are expected to behave appropriately while at the service or pharmacy, with violent or threatening behaviour a criteria for review and/or discharge from the MMT programme. It is therefore expected that consumers will have appropriate social interaction skills, and have cognitive skills in areas of executive functioning. It is expected that consumers would need similar cognitive skills in order to comply with the service criteria (e.g. no involvement in serious criminal activity and diversion of methadone, reduction in harmful or hazardous use of other drugs).

Therefore, individuals enrolled in the MMT programme need skills in the following areas in order to comply with different aspects of the programme: short term memory; retention/recall; long term memory; working memory; listening & attention skills; reading skills (minimum level of 9th grade/4th form equivalent); the ability to control impulsivity; insight, reasoning and judgement skills; the ability to problem solve; and planning skills. Impairments in these cognitive areas are likely to lead to missed doses, poor attendance at appointments, rule violation, difficulty maintaining abstinence, and difficulty achieving treatment goals, all of which have previously been associated with poor treatment adherence.

While cognitive impairments may be associated with treatment adherence and retention, the cause of these impairments remains unclear. These cognitive deficits may occur as a result of substance use, or they may be related to a pre-existing disorder, although, recent research has reported impairments associated with specific drug use. A further description of the cognitive impairments reported in substance using populations is outlined below.

Cognitive functioning of substance users

Previous research has suggested that a significant percentage of individuals with a substance use history have some type of cognitive impairment. Gillen, Kranzler, Kadden and Weidenman (1991) found that 25% of individuals seeking substance use treatment were classified as impaired on the basis of a neuropsychological exam. Research into the area of cognitive functioning in substance using populations has, however, been inconsistent, and much of the research that is available is limited in its application to general drug and alcohol populations due to stringent inclusion and exclusion criteria.

As mentioned previously, several research studies have suggested that individuals with cognitive impairments are more likely to drop out of treatment, and have increased difficulties compared to cognitively intact individuals if they remain in treatment (e.g. Cooney, Kadden, Litt, & Getter, 1991; Fals-Stewart & Lucente, 1994; Miller, 1991; Teichner, Horner, Roitzsch, Herron, & Thevos, 2002; Woods, Freitas, & Fas-Stewart, 1999). Research also suggests that impairments may be a perpetuating factor in the continued use and or abuse of alcohol and other substances (e.g.

Goldman, Brown, Christiansen, & Smith, 1991; Kleber et al., 2006). However, the specific cognitive impairments that individuals who seek alcohol and drug treatment experience remain unclear. A summary of the findings in relation to cocaine, opiates, and polysubstance use are outlined below.

Cocaine

In many countries cocaine is one of the most widely used illicit substances after cannabis (Smart & Ogborne, 2000). However, cocaine dependence is not often seen within the New Zealand setting due to the complexities of manufacture and customs checks (Wilkins, Girling, & Sweetsur, 2006). As such, the number of referrals for the treatment of cocaine abuse/dependence is small to almost non-existent in comparison to nearby countries such as Australia where cocaine and heroin use are often treated concurrently. Therefore, cocaine use was not considered to be relevant in the current research.

Opiates

Illicit opiates are used by an estimated 13.5 million people worldwide. This includes an estimated 9.2 million using heroin (World Health Organisation, 2002). In 1996, estimates placed opiate dependence in New Zealand at 13,500-26,600 individuals with an estimated increase of 15% a year (Sellman, Hannifin, Deering, & Borren, 1996). Boden, Fergusson and Horwood (2006) in a New Zealand longitudinal study found that 3.7% of individuals had used opiates by the age of 25 years.

Heroin and injecting drug use first became widespread during the 1970's, and subsequently during this time many countries first introduced MMT programmes (Thornton, 1991). Since the 1970's, the supply of heroin in New Zealand has reduced substantially due to the increased interception of imports by police and customs officials. To replace this 'lack of supply', heroin manufacture became another 'Kiwi invention' using over the counter products containing codeine as a base to convert to morphine, and subsequently heroin – commonly known as 'homebake' (Bedford, Nolan, Onrust, & Siegers, 1987; Carnwath & Smith, 2002; Hannifin, 1997; Thornton, 1991). More recently, opium poppies have been grown and cultivated in New

Zealand, and overseas heroin has become increasingly available, however, the large majority of is still ‘homebake’ (Carnwath & Smith, 2002).

While heroin remains the main opiate used in many overseas countries, in New Zealand the most common opiates of abuse are methadone and morphine (Geevasinga, Moriarty, & Robinson, 2003). Other opiate forms that are commonly seen are pharmaceutical based drugs, such as codeine.

As with other substances, opiates have been linked to deficits in cognitive functioning. For example, Lyvers & Yakimoff (2003), using the Wisconsin Card Sorting Test (WCST), found that opioid dependence, like alcohol and cocaine addiction is associated with a disruption of executive cognitive functions and with possible changes in brain function that could lead to long-term deficits. Heroin users (in various types of substitution treatment programmes) have also been reported to have deficits in abstraction and learning, spatial working memory, and to make more perseverative errors on tasks when using the Cambridge Neuropsychological Test Automated Battery (CANTAB), however, they obtained above average scores on the National Adult Reading Test (NART) (108.9) (Ornstein, Iddon, Baldacchino, Sahakian, London, Everitt, & Robbins, 2000). Overall, however, as with other substances, the literature on the impairments in opiate users is inconsistent. The impairments that have been reported in individuals following the use of Heroin, Methadone, and other Opiates are outlined below.

Heroin

The prevalence of heroin dependence is estimated at between 3 –8 per 1000 adults in many overseas countries including Australia, Britain and wider Europe (Hall, Ross, Lynskey, Law, & Degenhardt, 2000). Estimates in New Zealand suggest that the prevalence of lifetime heroin use in individuals aged 13-65 years is 0.5% (Ministry of Health, 2007), although, as with overseas populations, this figure may be increasing, which could be as a result of a number of factors including increases in purity and availability (Hall, Ross, Lynskey, Law, & Degenhardt, 2000). As with the variation in access to heroin, the method of taking heroin tends to differ across countries with patterns in the UK showing more smoking and ‘chasing’ (approx 40% in treatment smoked heroin prior to entry) rather than injecting of heroin, which was the sole route of administration in Australia until the late 1990’s (Maher, Dixon, Hall,

& Lynskey, 1998). The route of heroin administration in New Zealand does not appear to have been researched.

Heroin is viewed as a highly addictive drug, and recent evidence suggests this may be due to chemical changes that occur in the brain of the individual after initial experimentation. Research suggests that individuals develop a cognitive processing bias where by individuals excessively focus on drug-related cues (Franken, Kroon, Weirs, & Jansen, 2000; Franken, Stam, Hendriks, & van der Brink, 2003). Research also suggests that heroin users often have little insight into their own risks of overdosing, in fact they appear to underestimate this risk significantly (Warner-Smith, Lynskey, Darke, & Hall, 2001). In addition to this, heroin users have been reported as showing other cognitive deficits such as impairment in attention (e.g. Guerra, Solé, Camí, & Tobeña, 1987; Prosser, Cohen, Steinfeld, Eisenberg, London, & Galynker, 2006; Verdejo, Toribio, Orozco, Puente, & Perez-Garcia, 2005), but not all research agrees with this (Fields & Fullerton, 1975; Guerra, Solé, Camí, & Tobeña, 1987; Pau, Lee, & Chan, 2002; Roberts & Horton, 2000). Perception abilities have been reported as unimpaired in heroin users (e.g. Galski, Williams, & Ehle, 2000; Wang, Liu, Chen, Sun, Fu, Ma, He, Wang, Wilson, Carlson, & Ma, 2007).

Memory deficits have been more consistently reported in heroin using populations. Deficits in verbal and visual memory (Ersche, Clark, London, Robbins, & Sahakian, 2006; Fishbein, Hyde, Eldreth, London, Matochik, Ernst, Isenberg, Steckley, Schech, & Kimes, 2005; Fishbein, Krupitsky, Flannery, Langevin, Bobashev, Verbitskaya, Augustine, Bolla, Zvartau, Schech, Egorova, Bushara, & Tsoy, 2007; Prosser et al., 2006), and working memory (Fishbein et al., 2005; Fishbein et al., 2007; Guerra, Solé, Camí, & Tobeña, 1987; Verdejo, Toribio, Orozco, Puente, & Perez-Garcia, 2005) have been reported. However, findings are inconsistent, with some studies reporting no deficits in memory (Guerra, Solé, Camí, & Tobeña, 1987), while other studies have reported memory abilities superior to controls (Fields & Fullerton, 1975).

The verbal functioning of heroin users has been reported to be both impaired (e.g. Guerra, Solé, Camí, & Tobeña, 1987; Prosser et al., 2006) and not impaired (Guerra, Solé, Camí, & Tobeña, 1987; Verdejo, Toribio, Orozco, Puente, & Perez-Garcia, 2005), while intellectual functioning has been reported as lower, on average, than the general population (e.g. Fishbein et al., 2005; Fishbein et al., 2007; Kirby &

Petry, 2004; Mintzer, Copersino, & Stitzer, 2005; Prosser et al., 2006; Verdejo, Toribio, Orozco, Puente, & Perez-Garcia, 2005).

Cognitive flexibility deficits have been inconsistently reported in heroin users. Deficits have been reported with regard to impulsivity (e.g. Fishbein et al., 2005; Fishbein et al., 2007; Heyman & Dunn, 2002; Kirby & Petry, 2004; Lee & Pau, 2002; Pau, Lee, & Chan, 2002; Verdejo, Toribio, Orozco, Puente, & Perez-Garcia, 2005), and decision making and problem solving (e.g. Fishbein et al., 2005; Fishbein et al., 2007; Petry, Bickel, & Arnett, 1998). In contrast, other studies have found no deficits in impulsivity (Fishbein et al., 2007), decision making and problem solving (Ersche, Roiser, Clark, London, Robbins, & Sahakian, 2005; Mintzer, Copersino, & Stitzer, 2005; Verdejo, Toribio, Orozco, Puente, & Perez-Garcia, 2005), mental flexibility and abstraction (Pau, Lee, & Chan, 2002), and cognitive flexibility (Verdejo, Toribio, Orozco, Puente, & Perez-Garcia, 2005). Psychomotor speed has been reported as both impaired (Fishbein et al., 2005; Fishbein et al., 2007) and not impaired in heroin users (Fishbein et al., 2005; Verdejo, Toribio, Orozco, Puente, & Perez-Garcia, 2005).

As with many other substances, the cognitive functioning of both current and abstinent heroin users varies across studies, although in general, memory, impulse control and inhibition appear to be impaired in the majority of studies. The inconsistent results to date could be attributed to a variety of factors including other substance use, measures used, and exclusion and inclusion criteria. Another factor that is likely to have influenced results that have been obtained in recent years is the increase of heroin use by middle class populations, where traditionally heroin has been seen as a ‘poor mans drug’ (Carnwath & Smith, 2002).

Methadone

Methadone is a synthetic substance that is chemically different from morphine, but has similar chemical actions and effects (Milroy & Forrest, 2000). When taken orally in a liquid form, methadone is absorbed well by the gastrointestinal tract, and has a typical half life of 10 to 18 hours, although it can last as long as 25 hours or more. Because of the long half life of methadone, it lends itself readily to the treatment of opiate dependence as individuals are not left feeling uncomfortable soon after they have consumed their dose (which can occur when methadone is injected, or with other opiate treatment options). Methadone has also been considered useful in

the treatment of opiate dependence as it does not create an instant euphoria and rush that many individuals associate with the pleasurable rush from heroin.

In addition to being a prescription medication, methadone is often used illicitly by opiate dependent individuals. Illicit methadone is usually methadone that has been prescribed and then diverted, either through the methadone being held in the mouth during observed consumption and then regurgitated, or through diversion of a prescribed 'takeaway' methadone dose. The impact of methadone on cognitive and neuropsychological functioning has not received as much attention as other substances such as alcohol, cannabis, cocaine or heroin and the research that does exist in this area has been inconsistent, as with other opiates.

Attention deficits have been reported in individuals on MMT programmes (e.g. Darke, Sims, McDonald, & Wickes, 2000; Mintzer & Stitzer, 2002; Prosser et al., 2006; Specka, Finkbeiner, Lodemann, Leifert, Kluwig, & Gastpar, 2000; Verdejo, Toribio, Orozco, Puente, & Perez-Garcia, 2005), but not all research agrees with this finding (Kelley, Welch, & McKnelley, 1978). Deficits in perception have also been reported, although not in distance perception and time estimation (Kelley, Welch, & McKnelley, 1978; Mintzer & Stitzer, 2002).

Memory deficits have been reported more consistently in individuals on MMT programmes. Deficits in memory in general (Ersche, Clark, London, Robbins, & Sahakian, 2006; Grevert, Masover, & Goldstein, 1977; Mason, Kocsis, Melia, Khuri, Sweeney, Wells, Borg, Millman, & Kreek, 1998; Prosser et al., 2006), working memory (Mintzer & Stitzer, 2002; Verdejo, Toribio, Orozco, Puente, & Perez-Garcia, 2005), meta memory (Mintzer & Stitzer, 2002), and long-term visual and verbal memory (Darke, Sims, McDonald, & Wickes, 2000) have been reported. Results have been less consistent when assessing short-term visual and verbal memory with studies both reporting both deficits (Curran, Kleckham, Bearn, Strang, & Wanigaratne, 2001; Darke, Sims, McDonald, & Wickes, 2000; Gritz, Shiffman, Jarvik, Haber, Dymond, Coger, Charuvastra, & Schlesinger, 1975; Kelley, Welch, & McKnelley, 1978) and no deficits (Kelley, Welch, & McKnelley, 1978). No impairments have also been reported when assessing long-term episodic memory (Mintzer & Stitzer, 2002).

Impairments in verbal functioning (Prosser et al., 2006), and learning (Gritz et al., 1975) have been reported, however, other research has disagreed with this finding (Verdejo, Toribio, Orozco, Puente, & Perez-Garcia, 2005). Overall, assessments of intellectual functioning in individuals on MMT programmes have reported lower

levels of intellectual functioning than found in the general population (e.g. Avants, Margolin, Warburton, Hawkins, & Shi, 2001; Darke, Sims, McDonald, & Wickes, 2000; Gruber, Tzilos, Silveri, Pollack, Renshaw, Kaufman, & Yurgelun-Todd, 2006; Mintzer, Copersino, & Stitzer, 2005; Prosser et al., 2006).

Deficits in the executive functioning of individuals on MMT programmes have been reported by the majority of studies in this area. Impairments in cognitive flexibility (Avants, Margolin, Warburton, Hawkins, & Shi, 2001; Verdejo, Toribio, Orozco, Puente, & Perez-Garcia, 2005), planning, problem solving and analogue reasoning (Darke, Sims, McDonald, & Wickes, 2000; Ersche, Clark, London, Robbins, & Sahakian, 2006; Heyman & Dunn, 2002; Mintzer & Stitzer, 2002; Verdejo, Toribio, Orozco, Puente, & Perez-Garcia, 2005), and impulsivity and inhibition (Ersche et al., 2005; Verdejo, Toribio, Orozco, Puente, & Perez-Garcia, 2005) have been reported. In contrast, some studies have found no impairments in cognitive flexibility (Gruber et al., 2006).

Psychomotor functioning deficits have been inconsistently reported. Some studies have reported deficits in psychomotor speed/cognitive speed (Mintzer & Stitzer, 2002), while others have found none (Gordon, 1970; Kelley, Welch, & McKnelley, 1978). Additionally, psychomotor functioning has been shown to improve after two months on methadone maintenance (Gruber et al., 2006).

To date, the research assessing the cognitive functioning of individuals on methadone maintenance has been inconsistent; however, findings generally suggest that impairments in attention, memory and cognitive flexibility are more likely when compared to both controls and other substance using samples. The inconsistency in findings could be the result of the wide variety of substances that are generally used by opiate populations, as well as comorbid alcohol and other drug issues. The time of the last methadone dose, the amount of time on methadone and whether an individual has stabilised on their methadone dose may have affect assessment results also.

Other Opiates

At least one study has examined the cognitive effects of Buprenorphine (an alternative treatment option to methadone). Madden, Petry, Badger and Bickel (1997) reported on a sample of 18 individuals receiving Buprenorphine treatment for a average of 3.7 months. Results indicated that individuals, when compared to controls,

showed impairments in impulsivity, but obtained intellectual functioning scores that were similar to the normal population.

In summary, the findings with opiate populations have been inconsistent; however, research generally suggests that impairments in attention, memory, and cognitive flexibility are more likely in opiate users than in the general population. Variations in the impairments noted above, differ with the type of opiate being used, and may have been influenced by ease of access (for example, individuals on MMT programmes have a constant supply of an opiate of a known quantity and quality). Therefore, further research is needed to ascertain the cognitive impairments that are present in opiate populations, and how these impairments may influence treatment adherence and retention.

Polysubstance Use

Increasingly, literature is suggesting that treatment of singular substance using individuals is rare, with the majority of individuals using at least one other substance in additional to their primary substance of choice (Campbell, 2001; Darke & Hall, 1995; Kandel, Huang, & Davies, 2001). Opiate users in particular, use a wide variety of substances such as alcohol, benzodiazepines, amphetamines and cocaine (Ward, Bell, Mattick, & Hall, 1997), and research suggests that they are likely to continue to do so even after they have enter treatment programmes such as MMT (Stitzer, Bigelow, Liebson, & Hawthorne, 1982). Research from South London suggests that polysubstance use is a major issue in opiate users seeking treatment, with 70% reporting concurrent heroin and crack cocaine use, and some individuals also reporting the use of diazepam (11%), methadone (9%) and cocaine powder (8%) in combination with heroin (Beswick, Best, Rees, Coomber, Gossop, & Strang, 2001).

Within New Zealand, and in some overseas countries, benzodiazepine use, in particular, is often seen in individuals receiving MMT (Stitzer, Bigelow, Liebson, & Hawthorne, 1982). Cannabis and alcohol use are also commonly seen (Campbell, 2001). Polysubstance use, as outlined above, does not always cease when individuals enter treatment. For example, Anglin (1989) assessed the use of alcohol by 375 individuals in treatment for heroin addiction, and found that alcohol and heroin use were inversely related, with individuals increasing their use of alcohol as heroin use decreased. Anglin (1989) also proposed that this is a lifelong pattern, with individuals

substituting other substances to compensate for the decrease in their primary substance of choice.

Research, such as that outlined in the previous sections, has suggested that there are greater levels of cognitive deficits in substance using populations than the general population. Similarly, this is likely to be true for polysubstance users; however, research has often excluded polysubstance users from samples, and has focused instead on individuals with a history of using only one substance. Research studies that have included polysubstance users have reported higher rates of impairments. For example, Bruhn and Maage (1975) found that 37% of polysubstance users were impaired two to three weeks after they entered treatment and 34% at three-month follow-up when assessed using the Halstead-Reitan. This is much higher than the rates reported earlier for individuals using single substances. The cognitive impairments reported, to date, with polysubstance users are summarised below.

The majority of studies that have included polysubstance users have reported no impairments in attentional abilities (e.g. Amir & Bahri, 1999; Barker, Bigler, Johnson, Anderson, Russo, Boineau, & Blatter, 1999; Beatty, Blanco, Hames, & Nixon, 1997; Bruhn & Maage, 1975; Horner, 1997; Kelly, Johnson, Knoller, Drubach, & Winslow, 1997; Reay, Hamilton, Kennedy, & Scholey, 2006). However, there are some studies that disagree with this finding (Heishman, Weingartner, & Henningfield, 1999; Lisdahl Medina, Shear, & Schafer, 2006). Few studies have assessed perception in polysubstance users, however, the studies that have, reported impairment in this area (Heishman, Weingartner, & Henningfield, 1999).

Reported memory deficits in polysubstance users have varied. Studies have found no impairments in visual memory (Bruhn & Maage, 1975), semantic memory (Bruhn & Maage, 1975; Horner, 1997), working memory and explicit recall (Bruhn & Maage, 1975; Nixon, Paul, & Phillips, 1998), and in memory and learning (Heishman, Weingartner, & Henningfield, 1999). Other studies have reported no impairments in verbal learning and memory (Horner, 1997; Lisdahl Medina, Shear, & Schafer, 2006), visuospatial learning and memory (Beatty, Blanco, Hames, & Nixon, 1997; Fishbein et al., 2007; Nixon, Paul, & Phillips, 1998; Reay, Hamilton, Kennedy, & Scholey, 2006; Selby & Azrin, 1998; Verdejo-Garcia, Lopez-Torrecillas, Aguilar de Arcos, & Perez-Garcia, 2005), and short-term memory (Bruhn & Maage, 1975; Croft, Mackay, Mills, & Gruzelier, 2001; Kelly, Johnson, Knoller, Drubach, & Winslow, 1997). However, the majority of studies with polysubstance users have reported deficits in

memory, including implicit memory (Gonzalez, Vassileva, Bechara, Grbesic, Sworowski, Novak, Nunnally, & Martin, 2005), verbal learning and memory (Barker et al., 1999; Horner, 1997; Kelly, Johnson, Knoller, Drubach, & Winslow, 1997; Reay, Hamilton, Kennedy, & Scholey, 2006; Selby & Azrin, 1998; Verdejo-Garcia, Lopez-Torrecillas, Aguilar de Arcos, & Perez-Garcia, 2005), short and long term memory (Bruhn & Maage, 1975; Fillmore & Rush, 2006; Fishbein et al., 2007; Grant, Contoreggi, & London, 2000; Heishman, Weingartner, & Henningfield, 1999; Horner, 1997; Kelly, Johnson, Knoller, Drubach, & Winslow, 1997; Nixon, Paul, & Phillips, 1998; Verdejo-Garcia, Lopez-Torrecillas, Aguilar de Arcos, & Perez-Garcia, 2005), working memory (Croft, Mackay, Mills, & Gruzelier, 2001; Fishbein et al., 2007; Horner, 1997; Nixon, Paul, & Phillips, 1998; Reay, Hamilton, Kennedy, & Scholey, 2006; Selby & Azrin, 1998), and general memory (Kandel, Huang, & Davies, 2001; Weaver, Madden, Charles, Stimson, Renton, Tyrer, Barnes, Bench, Middleton, Wright, Paterson, Shanahan, Seivewright, & Ford, 2003).

Studies assessing intellectual functioning in polysubstance users have reported scores well above the normative data (Callaly, Trauer, Munro, & Whelan, 2001; Kokkevi & Stefanis, 1995; Marsden, Gossop, Stewart, Rolfe, & Farrell, 2000; Milby, Sims, Khuder, Schumacher, Huggins, McLellan, Woody, & Haas, 1996; Ministry of Health, 2001b), similar to the normative data (Callaly, Trauer, Munro, & Whelan, 2001; Kokkevi & Stefanis, 1995; Rounsaville, Weissman, Kleber, & Wilber, 1982; Sellman, Hannifin, Deering, & Borren, 1996), and lower than the normative data (Callaly, Trauer, Munro, & Whelan, 2001; Gilewski, Zelinski, & Schaie, 1990; Kokkevi & Stefanis, 1995; Kosten, Rounsaville, & Kleber, 1982; Rounsaville, Weissman, Kleber, & Wilber, 1982; Sellman, Hannifin, Deering, & Borren, 1996; Zakzanis, Leach, & Kaplan, 1998).

Reported deficits in the cognitive flexibility of polysubstance users have varied also. Impairments have been reported in cognitive flexibility (e.g. Adrian & Barry, 2003; Aharonovich, Hasin, Brooks, Liu, Bisaga, & Nunes, 2005; Landro, Stiles, & Sletvold, 2001; Lezak, Howieson, Loring, Hannay, & Fisher, 2004; Porter, Gallagher, Thompson, & Young, 2003; Thakker, Ward, & Strongman, 1999), decision making and problem solving (e.g. Comijs, Deeg, Dik, Twisk, & Jonker, 2002; , 2000; Gilewski, Zelinski, & Schaie, 1990; Hilsabeck, Hassanein, Ziegler, Carlson, & Perry, 2005; Jones, 2001; Lezak, Howieson, Loring, Hannay, & Fisher, 2004; Ministry of Health, 2001a; Rehm, Bondy, Sempos, & Vuong, 1997; Single,

Robson, Rehm, & Xi, 1999), and impulsivity and inhibition (e.g. Corrigan, 2004; Darke, Ross, Hando, Hall, & Degenhardt, 2000; Degenhardt & Topp, 2003; Gossop, Stewart, Treacy, & Marsden, 2002; Strain, Brooner, & Bigelow, 1991). Conversely, some studies have found no impairments in decision making and problem solving (e.g. Avants, Warburton, & Margolin, 2000; Berglund, Leijonguist, & Horlen, 1977; Fals-Stewart, 1993; Fals-Stewart & Lucente, 1994; Fals-Stewart & Schafer, 1992; Field & Casswell, 1999; Katz, King, Schwartz, Weintraub, Barksdale, Robinson, & Brown, 2005; New Zealand Health Information Service, 2001; O'Leary, Donovan, Chaney, & Walker, 1979; Wilkins, Casswell, Bhatta, & Pledger, 2002), inhibition and impulse control (e.g. Barker-Collo, 2001; NZPA, 2005; Shepherd & Leathem, 1999; Tanaka-Matsumi, Seiden, & Lam, 1996; van de Vijver & Tanzer, 2004).

Psychomotor functioning has been studied less frequently in polysubstance populations; and the little research that has been done is inconclusive. The psychomotor functioning of polysubstance users has been reported as both impaired (Knight, 1984, , 1997; McKerracher, Rich, & Niven, 1988) and not impaired (Hammersley, 1995; Nelson, 1991; Strauss, Sherman, & Spreen, 2006).

Overall Findings on the Cognitive Functioning of Substance Users

Overall, research suggests that the use of substances or alcohol can result in short-term, if not long-term permanent damage to the brain. However, despite numerous research articles assessing the relationship between substance use and cognitive functioning impairments, results have been inconsistent and are often very unclear as to the relationship between the substance use and exact impairments. The findings to date, while being inconsistent, suggest that a large percentage of the drug and alcohol using population have some type of cognitive impairment that is likely to impact on the daily functioning of these individuals, and that these deficits are not commonly seen in the general population. At this time, more research is needed to assess the cognitive deficits that this population experiences, the impact of these deficits on daily functioning, and the impact of these deficits on treatment outcomes. Firstly, however, the reasons for the inconsistency in the results, to date, need to be identified. The reported impairments in the cognitive functioning of substance users could be influenced by a number of factors, including psychiatric disorders, health problems, head injuries and overdoses. Specifically in relation to opioid use and

cognitive functioning, reviews have highlighted issues regarding: absence of demographic information for comparison and small number of measures; measures not validated or reliable; lack of comparison samples; samples using other substances in addition to methadone (i.e. benzodiazepines); high number of head injuries; testing conducted prior to dosing therefore individuals may have been in withdrawal; limited information about current drug use; difficulties in differentiating between impairments attributable to acute dosing, chronic dosing, poly-drug abuse, and other confounding factors versus impairments that predated the opioid abuse (Mintzer, 2007).

While many studies aim to control for at least some of these confounding variables, the remaining uncontrolled variables could account for some of the inconsistency in the results reported. The most commonly identified confounding variables are discussed below.

Psychiatric Comorbidity

Substance using populations have been consistently shown to present with high rates of comorbid psychiatric disorders (Kandel, Huang, & Davies, 2001; Weaver et al., 2003), with research commonly suggesting a link between substance use and self-medicating behaviour. New Zealand research and service provision suggests that similarly high rates of comorbidity exist in the New Zealand population (Sunderland, Watts, Baddeley, & Harris, 1986).

Opiate populations, in particular, have been shown to have higher rates of comorbid psychiatric disorders than the general population with estimates suggesting up to 90% of individuals have a current or lifetime psychiatric disorder other than substance use disorders (Callaly, Trauer, Munro, & Whelan, 2001; Kokkevi & Stefanis, 1995; Marsden, Gossop, Stewart, Rolfe, & Farrell, 2000; Milby et al., 1996). The comorbid disorders identified most commonly include depression (Callaly, Trauer, Munro, & Whelan, 2001; Kokkevi & Stefanis, 1995; Rounsaville, Weissman, Kleber, & Wilber, 1982; Sellman, Hannifin, Deering, & Borren, 1996), anxiety (Callaly, Trauer, Munro, & Whelan, 2001; Kokkevi & Stefanis, 1995; Rounsaville, Weissman, Kleber, & Wilber, 1982), and personality disorders (in particular antisocial personality disorder) (Kokkevi & Stefanis, 1995; Kosten, Rounsaville, & Kleber, 1982; Rounsaville, Weissman, Kleber, & Wilber, 1982; Sellman, Hannifin, Deering, & Borren, 1996). Comorbid substance use disorders are also common, particularly

alcohol use (Rounsaville, Weissman, Kleber, & Wilber, 1982; Sellman, Hannifin, Deering, & Borren, 1996).

While comorbid psychiatric disorders may increase the complexities of treatment provision for individuals with alcohol and substance use disorders, psychiatric disorders have also been associated with poorer performance on a number of psychometric measures. For example, a number of studies have associated depression with memory deficits (e.g. Gilewski, Zelinski, & Schaie, 1990; Zakzanis, Leach, & Kaplan, 1998), as well as impairments in attention, executive functioning and other aspects of cognitive functioning (Aharonovich et al., 2005; Landro, Stiles, & Sletvold, 2001; Porter, Gallagher, Thompson, & Young, 2003). Impairments have also been associated with test anxiety, as well as higher levels of general anxiety (Lezak, Howieson, Loring, Hannay, & Fisher, 2004).

Health Impacts

Health related problems have been suggested as a confounding variable in the studies reporting cognitive impairments in alcohol and substance users. These health problems largely result from substance use, and include liver function abnormalities, gastrointestinal disorders, cardiovascular problems, and neurological problems in individuals in treatment for alcohol abuse/dependence (Adrian & Barry, 2003; Thakker, Ward, & Strongman, 1999). Health related consequences associated with alcohol and other substance use can also include blood born viruses such as Hepatitis C, Human Immunodeficiency Virus (HIV) and Acquired Immunodeficiency Syndrome (AIDS), respiratory diseases, heart disease, cancer and stroke (Jones, 2001; Ministry of Health, 2001a; Rehm, Bondy, Sempos, & Vuong, 1997; Single, Robson, Rehm, & Xi, 1999).

A link between memory complaints and health problems has been suggested, and this have influenced the results reported in the literature to date (Gilewski, Zelinski, & Schaie, 1990). The numerous different medications that are used to treat these health related problems could impact on functioning levels, which in turn could influence how and when treatment is sought, how treatment can be delivered, what diagnoses are given, and how treatment results are analysed. For example, research has suggested that interferon treatment for Hepatitis C may impact cognitive functioning, at least during the time that the individuals is on the treatment regime (Hilsabeck, Hassanein, Ziegler, Carlson, & Perry, 2005).

Other health related concerns that occur prior to treatment, such as head injuries or overdoses, may also influence psychometric assessment in this population, both in choice of measures and in results obtained. Given the number of possible comorbid problems, and that in many cases there are no visible signs of disability, staff may interpret these behaviours as being intentionally difficult on the behalf of the client group (Corrigan, 2004).

Polysubstance Use

As mentioned earlier, exclusive substance use has become less common among individuals seeking treatment for drug and alcohol use (Darke, Ross, Hando, Hall, & Degenhardt, 2000; Degenhardt & Topp, 2003; Gossop, Stewart, Treacy, & Marsden, 2002). In particular, individuals seeking treatment for opioid use often have a history of polysubstance use, which appears to increase the number of issues that these individuals experience. For example, Strain, Brooner & Bigelow (1991) found that, in a sample of 66 individuals enrolled in a methadone maintenance programme, the majority of individuals met the criteria for multiple substance use disorders, and that a greater number of substance use disorders were noted in individuals with other comorbid non-substance psychiatric disorders.

The use of a combination of different substances is likely to had lead to different impairments being reported by different individuals, in some of the studies mentioned previously. Differences in the substances that are available for consumption, the way these substances are produced, or the potency of substances, are also likely to have affected the impairments that have been reported. For example, within New Zealand research has suggested that the use of LSD and marijuana occur at similar rates to overseas countries; however, New Zealand has higher rates of ecstasy and amphetamine use; and lower rates of cocaine and tranquilliser use (New Zealand Health Information Service, 2001; Wilkins, Casswell, Bhatta, & Pledger, 2002). By comparison, other research has suggested that New Zealand has rates of alcohol, cannabis, and other drugs use that are similar to other countries, with the exceptions of hallucinogens which are used more frequently in New Zealand, and heroin and cocaine which are used more frequently in Australia (Field & Casswell, 1999). Given that substances use in New Zealand differs from that reported overseas, an important step in understanding the impact of substance use on cognitive

functioning with the New Zealand population is to examine what differences exist between drug use in this country and overseas.

Psychometric measures

A large number of different psychometric measures have been used to assess the cognitive functioning of individuals with alcohol and/or substance use. Psychometric tests that purport to measure the same areas of cognitive functioning often produce different results when administered to the same individual. This disparity in results suggests that these measures that may be measuring slightly different aspects of the same cognitive ability.

In addition, psychometric measures with poor validity and reliability are sometimes used, as are tests that have not been developed for the purposes for which they are used. A more thorough discussion of the influence of psychometric measures on research outcomes is included in the section titled *The Present Research*.

The Cause of Impairments

Despite the high rate of comorbidity between substance use disorders and psychiatric disorders, it is often unclear which precedes the other – are substances used as a coping mechanism, or as self-medication of a psychiatric disorder or other difficulty, or does the substance use occur first with psychiatric comorbidity occurring as a result? To the individuals themselves, this distinction may not appear to be important, however, an increasing amount of research is showing a link between maladaptive coping and substance use (Avants, Warburton, & Margolin, 2000).

The cause of substance related impairments is similarly complicated. As the majority of studies are conducted with individuals who have a long using history, and with limited available information regarding their cognitive functioning prior to substance use, it remains unclear whether cognitive impairments precede substance use, occur as a result of substance use, or are the result of a more complicated mixture of variables. As such, it may be difficult to ascertain the cognitive functioning of drug and alcohol populations with any clear certainty. Therefore, further research is needed to assess this possibility.

The Present Research

As outlined in the previous sections, research has suggested that alcohol and/or substance use is associated with cognitive impairments. However, the literature available, to date, has been unclear as to what form, exactly, these impairments take. Putative links are also being made between cognitive impairments and the poor adherence, retention and treatment outcomes that are often seen in services that cater to these populations.

A review of the services provided at the Community Alcohol & Drug Service (CADS) in Hamilton suggested that a number of cognitive skills are required for successful treatment adherence, and retention. These are: short term memory, retention/recall, long term memory, working memory, listening and attention skills, reading skills (minimum level of 9th grade/4th form equivalent), planning, insight, reasoning and judgement skills, and the ability to problem solve and control impulsivity. Similarly, previous research has suggested that individuals must be able to learn new information, and incorporate it into behaviour change (Fals-Stewart, 1993; Fals-Stewart & Lucente, 1994; Fals-Stewart & Schafer, 1992; Katz et al., 2005).

However, only a few studies in the United Kingdom and the United States have assessed the link between the cognitive skills needed and adherence, retention and treatment outcomes. Results from these studies suggest that cognitive impairment is associated with poorer treatment engagement, higher drop-out rates, faster relapse, poorer long-term outcomes, lower levels of motivation and higher levels of hopelessness (Berglund, Leijonguist, & Horlen, 1977; Fals-Stewart, 1993; Fals-Stewart & Schafer, 1992; Katz et al., 2005; O'Leary, Donovan, Chaney, & Walker, 1979). Cognitive impairment has also been associated with higher rates of psychiatric disorders, poor programme participation, increased rule violations, removal from programmes and shorter treatment episodes (Fals-Stewart & Lucente, 1994; Lyvers & Yakimoff, 2003).

As mentioned previously, adherence and retention in treatment has been poor. The current research aimed to assess possible reasons for poor adherence to treatment further. Specifically, the research aimed to assess the cognitive functioning of individuals receiving MMT in relation to their adherence to the treatment programme. To date, no research in New Zealand has examined this connection.

This research was carried out for a number of reasons. Firstly, studies have suggested that the use of substances within New Zealand varies from many overseas countries, due primarily to New Zealand's isolated geographical location. This isolation means that substances such as heroin and cocaine are not commonly accessible, and that alternative substances are either made, such as home bake heroin, or substituted, for example the use of cannabis is New Zealand in thought to be particularly high (NZPA, 2005). This difference in substance access and use may have affected the from and frequency of impairments observed in drug and alcohol populations in New Zealand.

A second factor involves how treatment services within a New Zealand context are managed and run. While many New Zealand services such as the Community Alcohol & Drug Service in Hamilton follow a harm reduction model to reducing substance use, New Zealand has specific guidelines that document the implementation of this service. Therefore, requirements for adherence to treatment programmes in New Zealand may differ from the requirements in many overseas services due to variations in how treatment protocols and requirements are implemented. As such, individuals may need different cognitive skills in order to comply with treatment regulations in New Zealand than those skills reported as necessary by studies overseas.

As mentioned previously, there has been much inconsistency in the impairments noted in substance using populations; however, the literature to date has suggested that impairment tends to increase with an increase in the number of substances that an individual uses regularly. The inconsistent, and often contradictory, findings regarding the cognitive functioning of substance using populations may be due to a number of factors including previous head injuries, overdoses and other health related issues. In addition to these factors, different psychometric measures have been used to assess the cognitive functioning of these populations. As such, comparison across studies is difficult, as psychometric tests purporting to measure the same cognitive ability produce differing results. As such, the first step in the present research was to identify appropriate psychometric measures to assess the cognitive functioning of these populations.

As discussed above, it is difficult, if not impossible in many cases, to disentangle the possible causes of cognitive impairment, in a population as diverse as that seen in the drug and alcohol field. Therefore, the present research intended to

look at the impact of drug and alcohol use on cognitive functioning, and aimed to draw some conclusions regarding a possible causal relationship. More importantly, however, this research examined the impact of cognitive impairments on treatment adherence. Essentially, this research aimed to identify the cognitive deficits present in this population, and strategies to improve the functioning of these individuals, both in treatment and in their daily lives.

Much previous research has used stringent exclusion criteria, which, while helpful in trying to pinpoint the cause of difficulties has given us little useful information for the population as a whole. This research, therefore, endeavoured to keep exclusion criteria to a minimum to allow for a truer representation of the population.

In order to assess the cognitive functioning of individuals in MMT at CADS in Hamilton, normative data for a New Zealand population needed to be obtained. The majority of measures that assess psychological functioning have been developed in the United States and the United Kingdom and these tests have not often been normed with other populations. As a result, research has suggested that many of the tests that are available may not be culturally appropriate. For example, New Zealand research assessing the use of the Boston Naming Test (BNT) and the California Verbal Learning Test (CVLT) found that New Zealand participants scored between 1.0 and 1.5 standard deviations below the American norms for these measures (Barker-Collo, 2001). Research with indigenous cultures that was carried out during colonisation also found that indigenous populations performed more poorly on measures of intellectual ability which at the time was used as an argument that European populations were superior, and gave some justification to the slavery movement. Since this time, however, it has become increasingly clear that the reason for this difference in performance is that these psychometric tests measured constructs that were unimportant in the cultural context (e.g. Shepherd & Leathem, 1999; Tanaka-Matsumi, Seiden, & Lam, 1996; van de Vijver & Tanzer, 2004).

Few studies have focused on psychometric measures that are appropriate for use with New Zealand populations. Indeed, there is little advice in the literature originating from New Zealand on measures that are even recommended. The most recent recommendations the researcher could find were provided by Knight and Godfrey (1984) who listed 20 most recommended psychometric measures for training and administration purposes, and McKerracher, Rich and Niven (1988) who listed

several measures that have previously been examined in New Zealand. Many of the measures recommended in these articles are no longer published and have been superseded by other measures.

Therefore, given the lack of normative data available for New Zealand, the first aim of this research was to determine the appropriateness of overseas psychometric norms for use in the New Zealand context, by recruiting a control sample from the University of Waikato. As part of this data collection, participants were questioned regarding their alcohol and substance use history in order to obtain a sample of non-using controls. In addition, those that reported current alcohol and drug use were included in a separate study to allow for further comparison.

Descriptions of the psychometric measures administered to the University Control sample are given below.

Psychometric Measures for Present Research

As mentioned previously, a review of the MMT programme at CADS Hamilton identified a number of skills that were required in order to comply with different aspects of the treatment programme. These were: short term memory, retention/recall, long term memory, working memory, listening & attention skills, reading skills (minimum level of 9th grade/4th form equivalent), insight, planning skills, reasoning and judgement skills, ability to problem solve and control impulsivity. As the present research was interested in the link between cognitive impairments and treatment adherence, the above cognitive skills were chosen for assessment.

Previous research in the substance use area has used a large number of different measures to assess cognitive functioning. However, concerns have been raised over the measures that have been used, in regards to both their validity and reliability, and to the use of these measures to assess different areas of functioning. For example, Knight (1997), in a review of the Wechsler Intelligence Scale-Revised, noted that the interpretation of WAIS profiles should always be informed by the individuals life history as well as results on other psychometric measures. Knight (1997) also noted that subscales of the WAIS should be read with extreme caution as the WAIS subscales were not made as stand alone measures, that individual scatter among subscales tests is common, and that a low or high score on one subscale means little without other background information. A number of research studies have also

developed their own assessment tools that, in many cases, have not been assessed or validated appropriately, while others have used measures which have been largely denounced as unreliable or unsuitable to measure particular aspects of functioning (Hammersley, 1995). Additionally, administration time has been criticised. Many test batteries require several hours to complete, and this can make the use of such batteries impractical. The costs associated with the administration of these test batteries (usually including substantial incentives) have been criticised also, as have the increased risks of finding a significant difference by chance, or finding contradicting results across measures (Hammersley, 1995).

For the present research, a review of the relevant literature was conducted to identify those psychometric measures that would be most appropriate to assess the cognitive functioning of an alcohol and drug population in New Zealand. In particular, the measures were assessed for their ease of administration and the time required for administration, the frequency of use in the literature to date, and their reliability and validity. The selected measures are outlined below.

The National Adult Reading Test – 2nd Edition (Nelson, 1991) was included in the test battery to assess premorbid IQ, as this is the most commonly used measure of intelligence in the area of alcohol and substance use research. The use of a common measure in this area, allowed for greater comparison across studies. The NART was selected over the Vocabulary subtest of the WAIS and demographic estimates as the NART is considered to be more accurate (Strauss, Sherman, & Spreen, 2006).

The Wechsler Memory Scale-III-Abbreviated (WMS-III-A) (Wechsler, 2002) was included in the battery as a measure of short and long-term visual and verbal memory. The WMS-II-A was chosen to assess memory functioning in this population as story recall (as demonstrated in the recall task required in the Logical Memory subtest) has been considered one of the strongest predictors of everyday memory performance, due possibly to the reconstructive process playing an important role in information retrieval in everyday life (Sunderland, Watts, Baddeley, & Harris, 1986). The WMS-III-A was chosen over other memory measures due to its shorter administration time (approximately 15-20 minutes with a 25-35 minute delay between subtests), validity and reliability data, and because it is a well recognised and commonly used measure.

The Wisconsin Card Sorting Test-Abbreviated (WCST-A) (Kongs, Thompson, Iverson, & Heaton, 2000) was selected to assess problem solving ability

and abstract reasoning ability. The WCST has been the measure used most commonly to assess this area of functioning, and the WCST-A is thought to measure the same construct while allowing for a reduced administration time (approximately 10 – 15). The WCST is also thought to measure working memory skills similar to those measured by the Wechsler Memory Scale-III, as measures on the WMS-III Working Memory Index and scores on the WCST (number correct, number errors, number of perseverative errors and conceptual level responses) have been reported as correlating significantly (Mahrou, Devaraju-Backhaus, Espe-Pfeifer, Dornheim, & Golden, 2000).

The Stroop Color and Word Test (Golden & Freshwater, 2002) was selected as a measure of impulse control and inhibition. The Stroop is one of the few measures available to measure impulse control and inhibition, and has been used in research with drug and alcohol populations often. Previous research has suggested that impairments in impulse control and inhibition are more likely in drug and alcohol populations, and that impairments in these areas may account for ongoing substance use by this population (Verdejo-Garcia, Lopez-Torrecillas, Orozco, & Perez-Garia, 2004). The Stroop requires approximately 5 minutes to administer.

The Trail Making Test (TMT) (Reitan, 1986) has been used to assess cognitive flexibility, attention, scanning and visuomotor tracking. The TMT was selected for this research as a measure of attention, both simple and divided, and cognitive flexibility as it is measure of these cognitive functions that is used most commonly in drug and alcohol populations. The TMT was also selected as a measure due to its short administration time, approximately 5 minutes.

Reading ability was also identified as an important component in the review of the CADS MMT programme. As such, the Wechsler Individual Achievement Test-II-Abbreviated (WIAT-II-A) (Wechsler, 2001) was included as a measure of reading and academic ability. Few research studies have assessed the reading ability of drug and alcohol populations, so the WIAT-II-A was selected as it is a well validated and commonly used measure to assess academic ability. It has a short administration time also (10-20 minutes).

The Beck Anxiety Inventory (BAI) (Beck & Steer, 1990) and Beck Depression Inventory-II (BDI-II) (Beck, Steer, & Brown, 1996) were included in the assessment battery to assess for the confounding effects of anxiety and depression. Previous research has suggested that anxiety and depression symptoms may affect

cognitive functioning negatively (Lezak, Howieson, Loring, Hannay, & Fisher, 2004). The BAI requires approximately 5 minutes to administer.

In addition to the assessment of cognitive functioning in this population, perceptions of treatment were assessed with regards to treatment adherence. To assess this area, the Treatment Perceptions Questionnaire (TPQ) (Marsden, Bacchus, Stewart, Griffiths, Clarke, Gossop, & Strang, 1998) was included in the test battery. The TPQ is a short self-report questionnaire that was developed for use with substance use populations, and has often been used in the literature to assess treatment satisfaction. The TPQ requires approximately 5 minutes to administer.

Outline of Studies

As discussed above, the first aim was to determine the appropriateness of overseas psychometric norms for use in New Zealand context, by recruiting a control sample of New Zealand university students who did not report current use of drugs or alcohol. Results of this study are presented in *Experiment 1*. In recruiting participants for this study, a large number of participants reported current alcohol use. As such, the second aim of this research was to explore the cognitive deficits of a group of university students that used alcohol. In addition to the University Alcohol Use sample, a sample of University Cannabis users was later recruited to explore the cognitive deficits of a group of university students that used alcohol and/or cannabis. The results of these studies are presented in *Experiment 2*.

The third aim of this research was to explore the cognitive deficits of a group of opiate dependent participants enrolled in MMT (*Experiment 3*). Recruitment for this sample was slow, so following the recruitment of only 15 participants over a one year period; the number of psychometric measures was reduced. Following the reduction in psychometric measures, a second sample of individuals in MMT was recruited. The findings from this study are reported in *Experiment 4*.

Given the difficulties in recruiting participants in *Experiment 3*, a concurrent sample of individuals, both in and out of treatment, with alcohol and substance use were recruited to explore the cognitive deficits of drug and alcohol participants, and to compare these groups' performances on the cognitive measures. The findings from the drug and alcohol sample are reported in *Experiment 5*, along with a comparison to the obtained MMT samples. In addition to the above aims, *Experiment 3*, *Experiment*

4, and *Experiment 5* aimed to assess the association between cognitive outcomes and adherence to treatment.

Following *Experiment 5*, a general discussion on the findings from this research is provided.

EXPERIMENT 1

Research has suggested that many psychometric assessment measures (measurement of psychological constructs, including personality, intelligence, and aptitudes (Reber & Reber, 2001)) used in recent times are culture specific in one way or another. For example, measures developed for predominately white European populations are unlikely to be generalisable to non-white non-European populations (Gopaul-McNicol & Amrmour-Thomas, 2001). Reynolds (1998) suggests that there could, therefore, be problems when using such measures and their normative data for populations other than those used for their development.

In more recent years, a number of studies have assessed the cross-cultural applicability of psychometric measures (e.g. Barker-Collo, 2001; Naglieri, Rojahn, Matto, & Aquilino, 2005; Shepherd & Leathem, 1999; Tanaka-Matsumi, Seiden, & Lam, 1996; van de Vijver & Tanzer, 2004), however, little research has assessed the use of such measures and their normative data in the New Zealand population. The limited findings available suggest that the normative data for psychometric measures developed overseas in countries such as America and the United Kingdom may have limited application in New Zealand. For example, Barker-Collo (2004) found that on the mean performance of New Zealand students on the Boston Naming Test was 1.2 standard deviations below the published American norms, and on the California Verbal Learning Test, a sample of 17 to 81 year old participants obtained scores between 1 and 1.5 standard deviations below the published American norms. Similarly, Fernando, Chard, Butcher and McKay (2003) found that a New Zealand sample differed significantly from the American normative data on the Rey Complex Figure Test. These differences may be the result of a cultural bias.

In contrast, other research has suggested that New Zealand scores do not differ significantly from the published American or United Kingdom norms. McKerracher, Rich and Niven (1988), assessed the use of the Eysenck Personality Questionnaire in a sample of New Zealand students, and found that obtained scores were comparable with British norms. Similarly, Rodriguez, Treacy, Sowerby and Murphy (1998) assessed the use of the Wechsler Intelligence Scale for Children-Third Edition and the Stanford-Binet Intelligence Scale and found results comparable to American norms.

As explained in the *Introduction*, the aim of this study was to determine the appropriateness of overseas psychometric norms for use in New Zealand context by obtaining a control sample of New Zealand university students who did not report current use of drugs or alcohol, and to assess the normative data of the psychometric measures selected, for later studies. At the time of this research, none of the chosen psychometric measures had been validated with a New Zealand population. Prior to any further studies, information on the use of these measures with a New Zealand population was required.

METHOD

Participants

Forty-eight participants, recruited from undergraduate and graduate courses at the University of Waikato, were interviewed, one of these was excluded due to poor level of English as they were unable to read and understand tests administered. Of the remaining research participants, 7 were male and 40 female. Their ages ranged from 17 to 61 (mean = 24.49, SD 9.28). The majority of participants self-identified as New Zealand European/Pakeha (48.93%), with the remaining participants identifying as Other European (12.76%), New Zealand Maori (10.64%), Maori/European (6.38%) and Other (21.29%). Forty participants (85.1%) had English as a first language with the remaining 7 participants having learned English as a second language as part of their school education.

Materials

The psychometric measures administered in this study were those chosen following a review of the MMT programme at CADS Hamilton. This review highlighted a number of cognitive skills required to adhere to treatment, and the psychometric tests chosen to assess these cognitive skills in later studies were the same as outlined in this study. A summary of each of the measures is provided below.

Beck Anxiety Inventory (1990, 1993)

The Beck Anxiety Inventory (BAI) (Beck & Steer, 1990) is a 21-item self-report inventory that broadly assesses the symptoms of both physiological and

cognitive anxiety. This measure requires the individual to read each question and rate their anxiety on a scale of 0 to 3 based on their experiences during the week prior to administration. Scores for overall anxiety are provided, as well as means and standard deviations for obsessive-compulsive disorder, panic disorder with agoraphobia, generalised anxiety disorder, panic disorder without agoraphobia and social phobia. The BAI requires approximately 5 - 10 minutes to administer and can be used with individuals 17 through 80 years.

The BAI was standardised on a sample of 1086 psychiatric outpatients, and, additionally, on a sample of 160 outpatients. Internal consistency for this measure has been shown to be high (Cronbach coefficient alpha = .92), as has content validity, concurrent validity and discriminate validity, and compares well with other measures of anxiety (Beck & Steer, 1990). However, research suggests that scores are significantly related to gender, with women scoring higher than men, and to age, with younger individuals reporting more severe levels of anxiety (Beck & Steer, 1990). In the current study, obtained data were compared to the non-clinical sample referred to in the manual.

Beck Depression Inventory – Second Edition (1996)

The Beck Depression Inventory – Second Edition (BDI-II)(Beck, Steer, & Brown, 1996) is a 21-item self-report inventory that assesses the symptoms of depression, including affective, behavioural, somatic, cognitive, and motivational components, and suicidal ideation. The measure requires the individual to read each question and rate their level of depression on a scale of 0 to 3 for the two weeks prior to administration. The BDI-II requires approximately 5 minutes to administer and can be used with individuals 13 through 80 years. Versions of the BDI have commonly been used as a measure of depressive symptomology since the items correlate with the Diagnostic and Statistical Manual Fourth Edition (DSM-IV) criteria for depression (Bjork et al., 1999).

The BDI-II was standardised on a large clinical sample (N=500), and 120 controls and has shown improved clinical sensitivity compared to previous versions of the test, with the BDI-II reliability coefficient alpha/internal consistency of 0.92 (Beck, Steer, & Brown, 1996). The BDI-II has been shown to have good test-retest reliability (0.93) also. The BDI-II has been shown to be more closely related to the DSM criteria for depression than the previous BDI, however, the two versions are

largely comparable with a correlation of .93 (Beck, Steer, & Brown, 1996). In the current study, obtained data were compared to the university sample referred to in the manual.

National Adult Reading Test – Second Edition (1991)

The National Adult Reading Test – Second Edition (NART-II) (Nelson, 1991) was developed to assess the premorbid intelligence levels of individuals suspected of suffering from a dementing process, however, it has been more commonly used to assess the premorbid intelligence of individuals (Crawford, 1992). As a result, the NART is the most widely used test to estimate premorbid intelligence, and has been used to provide a comparison standard for client performance on the Wechsler Scales (Wechsler Adult Intelligence Scale, Wechsler Memory Scale) (Crawford, Allan, Cochrane, & Parker, 1990; Crawford, Deary, Starr, & Whalley, 2001). The NART has also been used in research with the drug and alcohol population when testing cognitive functioning due to its relative imperviousness to brain damage (which is seen with a higher frequency in this population) (Darke, Sims, McDonald, & Wickes, 2000; Kelly, Johnson, Knoller, Drubach, & Winslow, 1997; Taylor, Kreutzer, Demm, & M, 2003). The NART is often considered one of the best measures of premorbid intelligence and research suggests it is a better indicator of premorbid functioning than the commonly used demographic measures approach (Pickholtz & Williams, 1997). However, it should be noted that the NART-II has not been validated against recent versions of the Wechsler Memory Scale and Wechsler Adult Intelligence Scale, although recent research suggests that the NART-II correlates highly with the WAIS-III (Mathias, Barrett-Woodbridge, & Bowden, 2004; Sullivan, Senior, & Hennessy, 2000).

The NART gives an accurate measure of intelligence by assessing the participants ability to read 50 non-phonetic words - an intellectual function that remains largely intact after dementia, strokes or head injury (Strauss, Sherman, & Spreen, 2006). The individual's responses are scored as correct or incorrect according to pronunciation. The overall score can be used to derive an estimate of premorbid IQ (from 69 to 131), as well as provide estimates of verbal and performance skills. The NART has been developed to be used with individuals 20 – 70 years, and takes approximately 5 minutes to administer.

Reliability and validity information is sparse in the NART manual. Reliability is reported as high for split (.93), interscorer (.96 – .98) and test–retest (.98). Similarly, validity is reported as loading highly on *g* (.85) (Nelson, 1991).

The Stroop Color & Word Test (1978, 2002)

The Stroop Color and Word Test (Golden & Freshwater, 2002) has had many reincarnations since its first development but all versions assess an individual's ability to read out words in ink colours different from the colour that the word exemplifies. This measure is used most commonly to assess attention and concentration (Lezak, Howieson, Loring, Hannay, & Fisher, 2004; Strauss, Sherman, & Spreen, 2006), however, it is also used as a measure of impulse control and inhibition (Mitrushima, Boone, & D'Elia, 1999; Strauss, Sherman, & Spreen, 2006).

The Stroop task consists of a page with colour words printed in black ink, a page with 'Xs' printed in colour, and a page with words from the first page printed in colours from the second page (the colour and the word do not match). The examinee looks at each sheet and moves down the columns, reading words or naming the ink colours as quickly as possible within a time limit. The test yields three scores based on the number of items completed on each of the three stimulus sheets. In addition, an interference score, which is useful in determining the individual's cognitive flexibility, creativity, and reaction to cognitive pressures can be calculated.

The 2002 Examiner's Manual (Golden & Freshwater, 2002) provides updated scoring, norms, and interpretations for ages 15-90 years. The Adult version was developed for individuals 15 years and over (with a child version available) and takes approximately 5 minutes to administer. The normative data provided in the 2002 manual was used for analysis.

There are a number of versions of the Stroop available (e.g. Delis, Kaplan, & Kramer, 2001; Golden & Freshwater, 2002; Spreen & Strauss, 1998; Trenerry, Crosson, DeBoe, & Leber, 1989), and research suggests that reliability across the different versions is high. Test-retest reliability ranges from .70 to .89 (Golden, 1978). Other reliability and validity information is not provided in either of the Stroop Manuals (Golden, 1978; Golden & Freshwater, 2002). Gender differences have been commonly reported on the colour naming aspect of this measure, with women demonstrating superior colour naming skills (Golden, 1978).

Trail Making Test (1944)

The Trail Making Test (TMT) (Reitan, 1986) was originally developed as part of the Army Individual Test Battery (1944) and has since been used as a stand-alone measure to assess speed, attention and mental flexibility (Strauss, Sherman, & Spreen, 2006). The TMT has been used to measure a wide variety of cognitive functions including scanning, visual search, psychomotor functions, sequencing abilities, mental tracking, mental flexibility, and concentration (Mitrushima, Boone, & D'Elia, 1999), but it has been used most commonly to assess cognitive flexibility, divided attention, scanning and visuomotor tracking (Lezak, Howieson, Loring, Hannay, & Fisher, 2004; Strauss, Sherman, & Spreen, 2006).

The TMT consists of two parts, composed of 25 circles containing numbers in Part A and numbers and letters in Part B. On Part A the individual is instructed to draw a line to connect the numbers in sequence as quickly as possible. On Part B the individual is instructed to connect the numbers 1-13 and the letters in alternating order (e.g. 1-A-2-B-3-C) as quickly as possible. Scoring is based on the time taken to complete each part. This measure has an administration time of approximately 5 minutes and can used with individuals 15 years and older. A children's version is available for individuals aged 9 –14 years.

Normative data for the TMT was originally provided in relation to cut-off scores (Reitan, 1986) although more recently research studies have provided more accurate normative data which accounts for age, gender, ethnicity and IQ. Mitrushima, Boone, and D'Elia (1999) list over 40 studies that have assessed the validity and reliability of the TMT, although studies often use different criteria for analysing the results. The TMT has been shown to have reliability and validity in the 0.90 to 0.98 range, however, this varies with differences in test administration (Spreen & Strauss, 1998), and has been reported to be sensitive to closed head injuries, alcohol abuse and poly-substance abuse (Spreen & Strauss, 1998).

Currently, the only New Zealand normative data available for the Trail Making Test are for older adults (Siegert & Cavana, 1997), however a number of different scoring options are available for the Trail Making Test based on overseas populations (Lezak, Howieson, Loring, Hannay, & Fisher, 2004; Mitrushima, Boone, & D'Elia, 1999; Strauss, Sherman, & Spreen, 2006). For the purposes of this research, the normative data provided by Tombaugh (2004) were used for analysis. These data were based on 911 individuals aged 18-89 years. The normative data from Tombaugh

(2004) were chosen over other normative data available as they include a large non-clinical sample which controlled for mental state and depression using the Mini Mental Status Exam and the Geriatric Depression Scale respectively. The normative data provided by Tombaugh are also relatively recent, are readily accessible, and are considered to be of a higher standard than other normative data provided for this measure (Strauss, Sherman, & Spreen, 2006)

Wechsler Intelligence Achievement Test–II–Abbreviated (2001)

The Wechsler Intelligence Achievement Test–II–Abbreviated (WIAT-II-A) (The Psychological Corporation, 2001) was developed to identify and track basic academic skills, and as a tool to develop interventions for children and adults. The WIAT–II–A consists of three subtests (Spelling, Word Reading, and Numerical Operations) from the full version of the Wechsler Individual Achievement Test–Second Edition (WIAT–II). The WIAT–II–A requires approximately 10 to 20 minutes to administer and can be used with individuals 4 to 89 years.

Reliability and validity measures for the WIAT-II-A have been assessed for each of the ages/age groups for which norms are provided, with split-half and inter-item reliability coefficients ranging from 0.71 to 0.99, and test-retest reliability ranging from 0.91 to 0.99. Validity measures suggest that the WIAT-II-A assesses similar constructs of achievement to other tests in the area, and correlates well with the original WIAT measure, with correlations ranging from 0.78 to 0.86 (Wechsler, 2001).

Wechsler Memory Scale–III–Abbreviated (1997)

The Wechsler Memory Scale–III–Abbreviated (WMS-III-A) (Wechsler, 2002) was developed as a shortened version of the WMS-III, and is used to assess auditory and visual memory, and provides an overall indication of memory functioning. The test provides scores for immediate and delayed auditory memory, immediate and delayed visual memory as well as index scores for immediate memory, delayed memory and a general memory index. As the name suggests, the Immediate Memory score indicates how individuals perform on tasks that require immediate recall. The Delayed Memory score indicates how individuals perform on tasks that required delayed recall – after a delay of approximately 30 minutes. The WMS-III-A was designed for use with individuals 16-89 years, and can be administered in

approximately 15-20 minutes with a 25-35 minute delay between administration of Logical Memory I and Family Pictures I, and Logical Memory II and Family Pictures II.

Reliability and validity of the WMS-III-A has been assessed for each of the age groups for which norms are provided (13 age bands from 16-89 years), with split-half and inter-scorer reliability coefficients ranging from 0.72 to 0.95, and test-retest reliability ranged from 0.61 to 0.80 on the subtest scores and 0.71 to 0.81 for the index scores. Validity measures suggest that the WMS-III-A assesses similar memory constructs to other tests in the area, and compares well with other measures that assess the recall of visually complex information (Wechsler, 2002). More recently, research has also suggested that the Family Pictures subtests heavily rely on verbal abilities, and may be a better measure of general memory and aspects of working memory (Chapin, Busch, Naugle, & Najm, 2008; Dulay, Schefft, Testa, Fargo, Privitera, & Yeh, 2002; Lezak, Howieson, Loring, Hannay, & Fisher, 2004; Lichtenberger, Kaufman, & Lai, 2001).

Wisconsin Card Sorting Test – Abbreviated (1981, 1993, 2000)

The Wisconsin Card Sorting Test (WCST) (Kongs, Thompson, Iverson, & Heaton, 2000) was developed as a measure of executive functioning, including abstract reasoning ability, mental flexibility and problem solving ability in particular, while requiring an individual to keep track of correct/incorrect responses. The WCST is also commonly used as a measure to gain evidence of frontal lobe lesions and other forms of brain dysfunction (Kongs, Thompson, Iverson, & Heaton, 2000), and has been used as a measure of working memory.

The full version of the WCST is one of the most commonly used psychometric measures, and has been used to assess the cognitive functioning of individuals in the drug and alcohol field (Aharonovich, Hasin, Brooks, Liu, Bisaga, & Nunes, 2005; Bartzokis, Lu, Beckson, Rapoport, Grant, Wiseman, & London, 2000; Bechara & Martin, 2004; Hoff, Riordan, Morris, Cestaro, Wieneke, Alpert, Wang, & Volkow, 1996; Lezak, Howieson, Loring, Hannay, & Fisher, 2004; Pirastu, Fais, Messina, Bini, Spiga, Falconieri, & Diana, 2006). The WCST-Abbreviated and the WCST full version require the same cognitive skills, and the majority of what is known about the

full version of the WCST can be applied to the abbreviated version (Kongs, Thompson, Iverson, & Heaton, 2000; Mitrushima, Boone, & D'Elia, 1999).

The full and abbreviated version of the WCST employs four stimulus cards and 64 (abbreviated) and 128 (full version) response cards with varying colours, shapes and forms. Participants are required to match the response cards with the four stimulus cards across changing conditions and are only told if they have responded correctly or incorrectly. Conditions including matching the four stimulus cards on colour, form, and shape. Scores are recorded for: total number of correct responses, total number of errors; number of perseverative responses; number of nonperserverative errors; number of perseverative errors; and number of categories completed. The WCST was developed to be used with individuals 6.5 – 89 years. The abbreviated version of the WCST has 64 cards and takes approximately 10 – 15 minutes to administer, although there is no time limit.

Reliability and validity data for the WCST-A, which are based on the full version of the WCST, show good internal consistency (ranging from 0.60 to 0.85), and good construct and cross-cultural validity which suggest the WCST-A is a useful measure for differentiating brain dysfunction (Kongs, Thompson, Iverson, & Heaton, 2000).

Procedure

Prior to the commencement of this research, ethical approval was obtained from the Psychology Department Human Research Ethics Committee at the University of Waikato.

Recruitment of participants took place between June 2004 and December 2005 within the Psychology Department at the University of Waikato. Participants were recruited through sign up sheets posted on notice boards within the Psychology Department at the University of Waikato. The information sheet (see Appendix I) gave details of the research and also explained that the research was both voluntary and confidential. Participants who agreed to participate were asked to leave their contact details for the researcher to contact them. Participants were allowed to claim a small course credit if they were presently enrolled in a first year psychology course. Once individuals had agreed to be contacted, the researcher either emailed or called participants to arrange a time to meet to complete the research.

At the time of the interview, participants were again provided with the information sheet stating that the research was both voluntary and confidential, and were asked to sign a consent form, after the details of the research had been explained and participants had any questions about the research answered (See Appendix II). Participants were also informed of the limits of confidentiality surrounding harm to self or others. Individuals who agreed to take part in the research were firstly administered a brief demographic questionnaire, and then were administered the neuropsychological tests as outlined in the Materials Section. The demographic questionnaire included information on education level, previous substance use, and previous head injuries and overdoses (See Appendix III).

The neuropsychological tests were administered in a fixed sequence by the researcher as listed below.

Wechsler Memory Scale III – Abbreviated (WMS-III-A) (Logical Memory I and Family Pictures I)
Trail Making Test (TMT)
Stroop Color and Word Test
National Adult Reading Test (NART)
Wechsler Memory Scale III – Abbreviated (WMS-III-A) (Logical Memory II and Family Pictures II)
Wechsler Individual Achievement Test II - Abbreviated (WIAT-II-A)
Beck Anxiety Inventory (BAI)
Beck Depression Inventory (BDI-II)
Wisconsin Card Sorting Test – Abbreviated (WCST-A)

All interviews were conducted on a one on one basis in a room within the Psychology Department at the University of Waikato. As required by the ethics committee, at the completion of the research participants were provided with a list of drug and alcohol agencies, and mental health services should they have any questions, or wish to obtain assistance with any of the issues discussed in the research (See Appendix IV). Test administration took approximately 1.5 hours and was completed in one session.

Scoring and data entry

The neuropsychological tests were hand scored according to the respective manuals. The one exception to this was the Trail Making Test, where the results were scored according to the normative data provided by Tombaugh (2004). Participants were not provided feedback on their individual results. The one exception to this was high suicidal ideation scores on the BDI-II, as these were discussed with participants to further assess risk issues.

Analysis was conducted using SPSS Version 12. Analysis was based on the following scores for each measure: Wechsler Memory Scale-III-Abbreviated subtest and index scores; Wechsler Individual Achievement Test-II-Abbreviated scaled scores; Trail Making Test percentile scores; Stroop Color and Word Test T-Scores; National Adult Reading Test predicted IQ scores; Beck Anxiety Inventory Total score and severity rating; Beck Depression Inventory-II Total score and severity rating; and Wisconsin Card Sorting Test standard scores. All results were compared to the predetermined significance level of $p = 0.05$.

In the case of missing data, if only one answer was missing from a scale or subscale, an average value was calculated by the researcher. Otherwise data was coded as missing, and was not included in that section of the analysis.

RESULTS

This study was conducted to determine the appropriateness of overseas psychometric norms for use in New Zealand context, by recruiting a control sample of New Zealand university students who did not report current use of drugs or alcohol. A sample of 48 university students who reported no current use of alcohol or drugs were recruited from undergraduate and graduate courses at the University of Waikato. One participant was excluded due to a poor level of English, which left a final sample of 47 participants.

As shown in Table 1.1, the participants had a mean age of 24.49 years, were predominately female and had completed the equivalent of 7th Form or Year 13/NCEA Level 3. Almost half of the University Control sample were New Zealand European/Pakeha, followed by Other European, Maori, Maori/European and Other which included African American, Asian, Fijian Indian, Indian, Phillipino, Polynesian, Samoan and Sri Lankan.

Table 1.1

Demographic details of University Control sample

	Control Sample	
Age	24.49	SD 9.28, Range 17-61
Gender		
Male	7	14.9
Female	40	85.1
Handedness		
Left	8	17
Right	39	83
Education	13.68 years	SD 1.42, Range 12-17
Ethnicity		
NZ European	23	48.93
Maori	5	10.64
Maori/European	3	6.38
Other European	6	12.76
Other	10	21.29

Performance on the psychometric tests

Prior to any analysis, Shapiro-Wilks tests were conducted to assess the distribution of the data for normality. Results from this analysis suggested that for the University Control Sample, the scores from the following measures were not normally distributed: WMS Family Pictures I ($W = 0.95$, $df = 47$), WIAT-II-A Word Reading Score ($W = 0.90$, $df = 44$), TMT Part A Percentile Score ($W = 0.93$, $df = 47$), Stroop Color T-Score ($W = 0.94$, $df = 46$), BAI ($W = 0.88$, $df = 45$) and BDI-II ($W = 0.79$, $df = 45$), WCST-A Standard Total Number of Errors ($W = 0.92$, $df = 45$) and the WCST-A Conceptual Level Responses ($W = 0.92$, $df = 45$) (all at $p < 0.05$). Subsequently, transformations were conducted on the scores from these measures.

Square-root and inverse square-root transformations normalised the distribution of the scores for the following measures: WIAT Word Reading, Stroop Color T-Score, BDI-II, and WCST-A Standard Total Number of Errors and Conceptual Level Response. However, transformation using the Square-root, Log and Inverse Transformations did not normalise the distribution of the scores for the TMT Part A and Part B and BAI.

Where applicable, the normative population scores were transformed in the same way as the data to allow for comparison using a one-sample t-test. Data that were not normalised by transformation were compared using the standard t-test. While these data were not normally distributed, one sample t-tests were conducted as there is no non-parametric equivalent measure and t-tests are considered to be quite robust. However, the results from these measures should be interpreted with caution. One sample t-tests were then conducted to compare this sample's data to the published norms for each measure.

These one sample t-tests showed significant differences between the obtained and normative data for a number of the measures. A summary of these results is presented in Table 1.2. Significant differences between the obtained and normative data were found for the WIAT Word Reading and Spelling subtests, WIAT Composite Score, TMT Part A Percentile Score, all of the NART Scores (Full Scale, Verbal and Performance), the Stroop Color-Word T Score and Stroop Interference Score, as well as the WCST-A Standard Total Number of Errors and Conceptual Level Responses. Medium effect sizes using Cohen's *d* were obtained on the WIAT-II-A Composite Score and Stroop Interference T-Score, and large effects on the WIAT-II-A Spelling substest, and all measures of the NART-II. While large effect

sizes are recommended as the standard effect size to report (Cohen, 1992), both medium and large effect sizes have been reported in the current study due to the relatively small sample size. For all of these measures, the mean scores were higher than the normative data. Results for all other measures were not significantly different from the normative sample.

Given that this sample's scores differed from the normative means on several measures, the results were compared to the standard deviation ranges provided for each measure. The mean scores for this sample fell within one standard deviation of the test norm on all measures. Mean scores on the Beck Anxiety Inventory fell in the mild range and scores on the Beck Depression Inventory-II fell within the minimal range. A summary of the mean and standard deviation scores for each measure is provided in Table 1.3.

Relation between demographic and psychometric test results

It has been suggested that neuropsychological tests scores can be influenced by various factors including anxiety and depression, age, years of education, handedness and gender (Kennedy, 1981; Lezak, Howieson, Loring, Hannay, & Fisher, 2004; Mitrushima, Boone, & D'Elia, 1999; Stanton, Savageau, Aucion, Jenkins, & Zyzanski, 1984; Strauss, Sherman, & Spreen, 2006). In order to investigate these in this sample, a series of correlations were calculated.

As shown in Table 1.4, there was a significant correlation between the BDI-II and Stroop Word-T Score (positive correlation), and between the BAI and the BDI-II (positive correlation). The significant correlation between the BAI and BDI-II was similar to that reported by Beck and Steer (1990) in the Beck Anxiety Inventory Manual (r = 0.60). Based on the Pearson Correlations, anxiety and depression did not relate to the scores obtained on any of the measures. As such anxiety and depression were not included as covariates in any further analysis.

The correlation between age and obtained scores for the NART-II was calculated as this was the one measure that did not provide age adjusted normative data. As shown in Table 1.4, there was no significant correlation between age and the NART-II scores. The correlations between reported level of years of education and the WMS-III-A and the TMT were also calculated as these measures do not provide academically adjusted normative data. As shown in Table 1.4, these correlations were not statistically significant.

The correlation between handedness and the various TMT scores were calculated, as previous research has suggested that left handed individuals may perform more poorly on this measure (Tupper & Cicerone, 1990). As shown in Table 1.4, no significant correlations were found between any of the measures and handedness; however there were only a small number of left handed individuals in the sample. None of the correlations between gender and any of the psychometric measures were statistically significant.

TABLE 1.2

One sample t-test comparing University Control Sample to Normative Data, including means, standard deviations and Cohen's d

	Normative Mean	One Standard Deviation	University Control Mean	University Control SD	t	df	Significance	Cohens *d*
WMS Logical Memory I	10	3	10.33	2.68	0.52	46	NS	0.11
WMS Family Pictures I	10	3	10.93	2.63	0.73	46	NS	0.31
WMS Logical Memory II	10	3	10.47	3.01	1.69	45	NS	0.16
WMS Family Pictures II	10	3	10.19	3.21	0.00	45	NS	0.06
WMS Immediate Memory	100	15	102.26	14.89	0.67	46	NS	0.15
WMS Delayed Memory	100	15	104.77	15.27	1.58	45	NS	0.32
WMS Total Memory	100	15	102.70	15.10	0.77	45	NS	0.18
WIAT Word Reading	10	3.87	10.45	2.86	-38.69	43	*	0.12
WIAT Numerical Operations	100	15	100.30	15.10	-0.08	43	NS	0.02
WIAT Spelling	100	15	114.14	9.69	9.43	43	*	0.94
WIAT Composite	100	15	108.66	10.96	5.24	43	*	0.58
TMT Part A Percentile	50	16	53.72	29.29	2.01	46	*	0.11
TMT Part B Percentile	50	16	52.91	31.87	0.20	46	NS	0.09
Stroop Word T-Score	7.07	3.16	7.22	3.13	1.22	45	NS	0.02
Stroop Colour T-Score	50	10	50.19	9.93	0.44	45	NS	0.02
Stroop Colour-Word T-Score	50	10	54.60	9.38	2.89	45	*	0.46
Stroop Interference T-Score	50	10	54.16	7.66	3.58	45	*	0.42
NART Full Scale IQ	100	15	113.51	5.70	18.19	44	*	0.90
NART Verbal IQ	100	15	112.60	3.95	16.06	44	*	0.84
NART Performance IQ	100	15	113.70	5.09	21.48	44	*	0.91
Beck Anxiety Inventory	11.08	9.1	9.02	6.61	1.18	44	NS	-0.23
Beck Depression Inventory	3.54	3.15	2.93	2.62	1.40	46	NS	-0.28
WCST Total Number of Errors	10	3.87	9.97	4.08	-21.05	44	*	0.01
WCST Perseverative Responses	100	15	98.77	11.43	-0.83	44	NS	-0.08
WCST Perseverative Errors	100	15	97.60	12.01	-1.45	44	NS	-0.16
WCST Nonperseverative Errors	100	15	100.35	17.03	0.03	44	NS	0.02
WCST Conceptual Level Responses	10	3.87	9.80	4.06	-20.91	44	*	-0.07

* Significant at $p < 0.05$

TABLE 1.3

Means and Standard Deviations for Normative and University Control Sample

	Normative Mean	One Standard Deviation	University Control Mean	SD
WMS Logical Memory I	10	3	10.33	2.68
WMS Family Pictures I	10	3	10.93	2.63
WMS Logical Memory II	10	3	10.47	3.01
WMS Family Pictures II	10	3	10.19	3.21
WMS Immediate Memory	100	15	102.26	14.89
WMS Delayed Memory	100	15	104.77	15.27
WMS Total Memory	100	15	102.70	15.10
WIAT Word Reading	100	15	109.21	8.16
WIAT Numerical Operations	100	15	100.30	15.10
WIAT Spelling	100	15	114.14	9.69
WIAT Composite	100	15	108.66	10.96
TMT Part A Percentile	50	16*	53.72	29.29
TMT Part B Percentile	50	16*	52.91	31.87
Stroop Word T-Score	50	10	52.16	9.82
Stroop Colour T-Score	50	10	50.19	9.93
Stroop Colour-Word T-Score	50	10	54.60	9.38
Stroop Interference T-Score	50	10	54.16	7.66
NART Full Scale IQ	100	15	113.51	5.70
NART Verbal IQ	100	15	112.60	3.95
NART Performance IQ	100	15	113.70	5.09
Beck Anxiety Inventory	11.08	9.10	9.02	6.61
Beck Depression Inventory	12.56	9.93	8.58	6.87
WCST Total Number of Errors	100	15	99.42	16.65
WCST Perseverative Responses	100	15	98.77	11.43
WCST Persevertive Errors	100	15	97.60	12.01
WCST Nonperseverative Errors	100	15	100.35	17.03
WCST Conceptual Level Responses	100	15	96.56	16.49

* TMT results are presented in percentile scores. 1 SD below the 50th percentile is the 16th percentile

Table 1.4

Correlations between demographic and psychometric test results in the University Control Sample

	Correlation Coeffient (r)					
	Pearsons	Point Biserial	Point Biserial	Pearsons	Pearsons	Pearsons
	Age	Gender	Handedness	Years of Education	Beck Anxiety	Beck Depression
WMS Logical Memory I		0.011		0.067	-0.082	-0.163
WMS Family Pictures I		-0.166		-0.257	0.067	-0.059
WMS Logical Memory II		-0.045		0.063	0.035	-0.027
WMS Family Pictures II		-0.207		-0.205	0.023	-0.069
WMS Immediate Memory		-0.073		-0.085	0.004	-0.120
WMS Delayed Memory		-0.127		-0.069	0.037	-0.066
WMS Total Memory		-0.112		-0.071	0.015	-0.101
WIAT Word Reading		0.020			0.074	0.045
WIAT Numerical Operations		0.090			-0.093	-0.088
WIAT Spelling		-0.129			-0.070	-0.074
WIAT Composite		-0.015			-0.073	-0.080
TMT Part A Percentile		0.144	-0.187	0.010	0.194	0.013
TMT Part B Percentile		-0.164	-0.220	0.089	0.135	-0.103
Stroop Word T-Score		0.057			0.230	**0.305***
Stroop Colour T-Score		-0.003			0.010	-0.022
Stroop Colour-Word T-Score		0.044			0.065	0.024
Stroop Interference T-Score		0.110			0.000	0.056
NART Full Scale IQ	0.292	0.173			0.082	0.082
NART Verbal IQ	0.274	0.166			0.074	0.065
NART Performance IQ	0.282	0.194			0.075	0.069
Beck Anxiety Inventory		-0.123				**0.687***
Beck Depression Inventory		0.044			**0.687***	
WCST Total Number of Errors		-0.059			-0.161	-0.132
WCST Perseverative Responses		0.037			-0.080	-0.006
WCST Perseverative Errors		0.018			-0.214	-0.240
WCST Nonperseverative Errors		-0.143			0.097	-0.085
WCST Conceptual Level Responses		-0.128			-0.232	-0.246

* Significant at $p < 0.05$

DISCUSSION

The sample was recruited to compare the normative data for the psychometric measures to a New Zealand population. The sample obtained scores either in accordance with the normative means, or in several cases, significantly higher than the normative means. In particular, there were higher scores on the WIAT-II-A Word Reading and Spelling subtests, WIAT-II-A Composite Score, TMT Part A Percentile Score, all of the NART-II Scores (Full Scale, Verbal and Performance), the Stroop Color-Word T Score and Stroop Interference T-Score, as well as the WCST-A Standard Total Number of Errors and Conceptual Level Responses. While the findings on these measures were significantly different from the normative data, the obtained results were within one standard deviation of the normative data mean. The results for each of the measures are discussed below.

One of the difficulties in interpreting results from psychometric tests is that statistical significance may not equate to clinical significance. A result that is statistically significant may not be considered as impaired in the traditional sense (usually one or two standard deviations below the normative mean), and may not result in a noticeable change in behaviour compared to the normative population. Additionally, research suggests that it is relatively common for normally functioning individuals to obtain scores that fall higher or lower than the normative mean, but within one standard deviation (e.g. Kongs, Thompson, Iverson, & Heaton, 2000; Nelson, 1991). For this reason, psychometric results are usually interpreted in terms of clinical significance.

Clinically significant results are, by contrast to statistically significant results, considered to be of practical importance, as for a result to be considered clinically significant, a noticeable difference in behaviour must be apparent (McBurney & White, 2004). In psychometric test results, clinical significance is either discussed in relation to noticeable impairments in behaviour, or to noticeable improvements in behaviour, when behaviour is assessed over an extended period. Previously, research has suggested that one standard deviation below the normative mean is generally considered as indicative of clinically significant impairment (Kongs, Thompson, Iverson, & Heaton, 2000; Lezak, Howieson, Loring, Hannay, & Fisher, 2004;

Wechsler, 2002). As such, the scores obtained by the current sample did not differ in terms of clinical significance compared to the normative data.

Obtained results for the WIAT-II-A Word Reading and Spelling subtests, and WIAT-II-A Composite score were higher than the normative mean. It was expected that the sample would obtain results comparable to the normative data, as conversion of raw scores for this measure accounts for years of education and age, which may have differentiated the current sample from the normative sample otherwise. The significantly higher scores on these measures could suggest a difference in the educational standards in New Zealand compared to the American education system, on which the normative data are based. Overall, the results on the WIAT-II-A suggest that the sample had reading, spelling and mathematics abilities within the expected range.

Results for the TMT, while statistically significant from the normative mean for Part A, were within one standard deviation of the normative mean. As the means for both Part A and Part B of the TMT were higher than the normative data, this suggests that the sample was unlikely to have difficulties in simple attention, or divided attention and cognitive flexibility. Significantly higher results on the TMT Part A were unexpected, as Tombaugh (2004) reported that the normative data were unaffected by education in the comparative normative sample. It was expected that the current sample would be comparable to Tombaugh's (2004) sample, as Tombaugh (2004) also included university students in the normative sample, although scores from community dwellers were included in the normative analysis also.

The present sample obtained significantly higher scores on the NART-II, however, the means were within one standard deviation of the normative data. The findings for the current sample are higher than expected in comparison to the normative data. This may be due to the high level of education in the current sample. The influence of education on the obtained results for this measure are difficult to determine, as the test manual (Nelson, 1991) does not provide information on the education level of the normative sample.

Overall, the scores for the current sample were generally similar to the normative means, and in some cases slightly higher (although this may have been influenced by the education level of the sample). Given the similar results it appeared that were no large differences between the different populations and so the existing norms could be used in New Zealand. The normative data provided in the test

manuals (and by Tombaugh (2004) for the TMT) were therefore used in analysis in the other studies conducted as part of this research.

EXPERIMENT 2

As discussed previously, the aim of *Experiment 2* was to explore the cognitive deficits of a group of university students that used alcohol and/or cannabis who were recruited during *Experiment 1*. Previous research has suggested that there is a high prevalence of hazardous drinking (defined as six drinks for males and four drinks for females on one occasion (Alcohol Advisory Council of New Zealand, 2004)) among New Zealand tertiary students (Kypri, Langley, McGee, Saunders, & Williams, 2002), and illicit substance use also appears to occur on a regular basis in this population (Smart & Ogborne, 2000; Webb, Ashton, Kelly, & Kamali, 1996). The effect of alcohol and cannabis use by university students on their cognitive functioning has received some attention. A summary of the findings is provided below.

Alcohol Use

A recent New Zealand study by Kypri, Langley, McGee, Saunders and Williams (2002) showed that, in a sample of 1480 tertiary students, 83.2% had consumed at least one alcoholic drink in the last four weeks and that 60% of males and 58.2% of females typically drank more than the recommended level outlined by the Alcohol Advisory Council of New Zealand (ALAC) more than twice per week on average. In addition, 52% of males and 46% of females reported binge drinking (seven or more drinks on one occasion, and five or more drinks on one occasion for males and females respectively) in the last four weeks.

Previous research has suggested that impairments in the cognitive functioning of regular alcohol users may be noticeable even after short-term use (e.g. Fillmore, Carscadden, & Vogel-Sprott, 1998; Hannon, Butler, Day, Khan, Quitoriano, Butler, & Meredith, 1987; Sher, Martin, Wood, & Rutledge, 1997; Weissenborn & Duka, 2000, , 2003), with impairments being reported more consistently in long-term alcohol users (e.g. Clifford, 1990; Evert & Oscar-Berman, 1995; Fals-Stewart, Schafer, Lucente, Rustine, & Brown, 1994; Fein, Bachman, Fisher, & Davenport, 1990; Gruber & Yurgelun-Todd, 2001; Jones, Knutson, & Haines, 2003; McCrady & Smith, 1986; Moselhy, Georgiou, & Kahn, 2001; Oscar-Berman & Marinkovic, 2003). The short-term effects of alcohol have been assessed frequently in casual and regular drinkers, with research typically focusing on the drinking habits of college and university

students. Little research exists on the cognitive effects of alcohol use on university students in New Zealand, however, several studies have assessed the effects of alcohol in overseas populations. Some of these studies are outlined below.

In one such study, Hannon, Day, Butler, Larson and Casey (1983) found, in a sample of 92 university students who were casual drinker, that there was a relation between cognitive impairments as measured by the WCST and the length of consumption over a lifetime, for both males and females. These data suggest that there was a greater impairment with increased used. However, a later study by Hannon, Butler, Day, Khan, Quitoriano, Butler, and Meredith (1987) failed to replicate these findings.

In another study, Fillmore, Carscadden and Vogel-Sprott (1998) assessed the cognitive functioning of 27 male university students who were social drinkers. Results showed impaired information processing. This study did not assess other aspects of cognitive functioning. Similarly, Weissenborn and Duka (2000, 2003) found impairments in both memory and executive functioning for 96 acutely intoxicated university students with a history of alcohol use.

Others have studied students who are alcohol dependent. For example, Sher, Martin, Wood and Rutledge (1997) found impairments in visuospatial ability and motor speed of severely alcohol-dependent university students. Brown, Tapert, Granhol and Delis (2000), in a study involving alcohol dependent adolescents, reported a relation between performance on verbal and nonverbal retention tests and alcohol use, with poorer performance associated with greater use. In this same study, recent alcohol withdrawal was also associated with poor visuospatial functioning, and longer-term withdrawal was associated with poorer retrieval of both verbal and nonverbal information. Similarly, Moss, Kirisci, Gordon and Tarter (1994) reported poorer performance on measures of reading recognition, total reading, spelling achievement, and verbal and full-scale IQ in adolescents with alcohol abuse and dependence.

Binge drinking has also been associated with poorer performance on tests of cognitive functioning. For example, Goudriaan, Grekin, and Sher (2007) reported an associated between increased use/binge drinking and impaired decision making, on the IOWA Gambling Task, in university students. Findings also suggest that alcohol using adolescents made less perseverative and commission errors, obtained better scores on a visual memory measure, and that alcohol using males performed better

and alcohol using females performed worse than controls on the Wisconsin Card Sorting Test.

Other studies have, however, reported no impairments in short-term alcohol users. Eckardt, Stapleton, Rawlings, Davis and Grodin (1995) reported no impairments in the language skills, attention, motor skills, intelligence, or memory ability of alcohol dependent individuals during detoxification. Similarly, Fadardi and Cox (2006) reported no impairment in interference in social drinking university students compared to dependent alcohol users.

The above studies suggest that impairments, while not consistently reported, have been associated with greater alcohol consumption. Poorer performance has been reported on psychometric measures of memory, information processing, executive functioning, and academic abilities; however, further research is needed to assess the effects of short-term and casual alcohol use as most studies have focused on alcohol use in more severe users.

Cannabis Use

In addition to alcohol use, New Zealand research suggests that cannabis use is common in adolescents and young adults, with the Christchurch Health and Development Study (Fergusson & Horwood, 2000) reporting that 69% had tried cannabis by the age of 21 years. Within this sample, 24% had used cannabis on less than 10 occasions, while 9% met the criteria for cannabis dependence.

Long-term cannabis use has been reported as impacting upon cognition, memory, reward, pain perception and motor coordination areas of the brain, with larger deficits noted in tasks that require sustained attention (Hall & Solowij, 1998). The effects of cannabis appear to be most pronounced within 12-24 hours of ingestion with impairments during this time reported in attention, psychomotor skills and short term memory (Pope Jr., Gruber, & Yurgelun-Todd, 1995). Long-term impairment in functioning have been reported most frequently in individuals with an extensive history of cannabis use (Hall & Solowij, 1998).

In addition to the research with long-term cannabis users, there is some research on the effects of cannabis use in the cognitive functioning of casual users. Research with adolescents and university students has generally reported no impairments in casual users, however, regular to heavy use does appear to be related to impairment in cognitive functioning.

Jacobson, Mencl, Westerveld and Pugh (2004), assessed the cognitive functioning of 7 cannabis using individuals who were in their last year of high-school. The results for this study showed that these participants made more incorrect responses on the Conners Continuous Performance Test, a measure of sustained attention, and performed less accurately on a 2-back task, which assessed working memory, compared to a non-using control sample. No impairment was reported in selective and divided attention as measured by a computerised word recognition test.

Harvey, Sellman, Porter and Frampton (2007), in a more comprehensive assessment, administered the Wechsler Abbreviated Scale of Intelligence, several subtests of the Cambridge Neuropsychological Battery (motor screening, rapid visual information processing, spatial working memory, intradimensional extradimensional shift, paired associates learning, spatial span), the Rey Auditory Verbal Learning Test, the Digit Span, and the Symbol Digit Modalities Test to a New Zealand sample of 70 non-regular and regular cannabis using adolescents. They found that the regular users had significantly poorer performance than the non-regular users on all measures of executive functioning and working memory (i.e. the Rapid Visual Information Processing A, Spatial Working Memory total errors, Spatial Working Memory strategy, and the sum of Trials A1 to A5 on the Rey Auditory-Verbal Learning Test).

Similarly, Schwartz, Gruenewald, Klitzner and Fedio (1989) assessed the cognitive functioning of 8 cannabis dependent adolescents and found impairments in memory when assessed using the Benton Visual Retention Test and Wechsler Memory Scale Prose Passages. Pope and Yurgelun-Todd (1996) assessed cognitive functioning in university students who were categorised as regular (maximum of 9 days in last 30) or heavy users (minimum of 22 days in last 30). Impairments were reported for heavy users, but not light users, on the preservation measures of the WCST, in memory on the delayed recall of figures on the WMS, in learning ability on the California Verbal Learning Test, and in immediate recall on the Rey-Osterreith Complex Figure Test. No significant differences were reported between the two groups on the Stroop when used as a measure of attention and interference.

By contrast, Fried, Watkinson and Gray (2005) assessed the cognitive functioning of 113 young adults who used cannabis, and found no impairment in memory, general functioning, vocabulary or concept formulation/abstract reasoning when assessed with the WMS-III, WAIS-III, Peabody Picture Vocabulary Test and Category Test respectively. Carlin and Trupin (1977) also reported no impairments on

the Halstead Reitan Neuropsychological Battery in a sample of 10 young adults who used cannabis. Similarly, Schaeffer, Andrysiak and Ungerleider (1981) found no impairment in the cognitive functioning of 10 cannabis using individuals when assessed with the Benton Visual Retention Test, Rey Auditory-Verbal Learning Test, Hooper Visual Modalities Test, Raven's Progressive Matrices Test and Trail Making Test.

As demonstrated by the studies outlined above, research has suggested that impairments in memory, attention and executive functioning appear to occur more frequently in cannabis using adolescents and university student populations compared to non-users, however, there have been some exceptions to these findings. Therefore, further research is needed to assess the effects of casual and short-term use of cannabis on cognitive functioning.

As mentioned previously, the aim of this study was to explore the cognitive deficits of a group of university students that used alcohol and/or cannabis.

METHOD

Participants

Forty-five of the participants recruited from the student population at the University of Waikato during *Experiment 1* met the requirements for this study. Thirty-nine of these reported using alcohol on a regular basis (at least once weekly) and were included in the University Alcohol sample. The 6 participants who reported using cannabis on a regular basis (at least once weekly) were included in the University Cannabis sample. Of these 6 participants, 2 reported using only cannabis, and 4 reported using both cannabis and alcohol on a regular basis (at least once per week). According to self report, none of the participants had used alcohol or cannabis in the 12 hours prior to assessment, and given the low frequency of use it is unlikely that these participants were dependent.

The University Alcohol sample included 10 male and 29 females. Their ages ranged from 17 to 52 (mean = 23.41, SD 7.33). The majority of participants self-identified as New Zealand European/Pakeha (46.15%), and the remaining participants identified as Other European (17.95%), New Zealand Maori (17.95%),

Maori/European (10.26%) and Other (7.69%). Thirty-three (84.6%) had English as a first language and the remaining 6 participants had learnt English as a second language as part of their school education.

The University Cannabis sample included 1 female and 5 males, ranging in age from 18 to 22 years (20.50, SD 1.517). The participants self-identified as European (83.3%) or Other European (16.7%). Participants had completed 14 years of education on average. Five of these 6 participants had English as a first language, and 1 participant had learnt English as a second language as part of their school education.

Materials

The psychometric measures administered to the University Alcohol sample were identical to those administered in *Experiment 1*. For further details on the neuropsychological tests administered please refer to the *Method* section for *Experiment 1*.

The University Cannabis sample was administered a reduced battery of psychometric tests. These were the Stroop Color & Word Test, Trail Making Test, Wechsler Memory Scale-III-Abbreviated and the Wisconsin Card Sorting Test-Abbreviated. For further information regarding the reduction in measures please see the *Introduction* to *Experiment 3*.

Procedure

The procedure for the University Alcohol sample was identical to that in *Experiment 1*. The procedure for the University Cannabis sample is outlined below.

Prior to the commencement of this research, ethical approval was obtained from the Psychology Department Human Research Ethics Committee at the University of Waikato.

Recruitment of participants for the University Cannabis sample took place between January and October 2007. Participants were recruited through sign up sheets posted on notice boards within the Psychology Department at the University of Waikato. The information sheet stated that the researcher was interested in contacting individuals who currently used substances; that the research involved tests of cognitive functioning; and that questions would be asked about current alcohol and/or drug use. The information sheet (see Appendix V) gave details of the research and explained that the research was both voluntary and confidential. The information

sheet provided the researcher's contact details (email, phone number and room number), and potential participants were asked to either make contact with the researcher, or leave their contact details and that the researcher would contact them. Participants were allowed to claim a small course credit if they were presently enrolled in a first year psychology course. Once individuals had agreed to be contacted or had contacted the researcher, the researcher either emailed or called participants to arrange a time to meet to complete the research.

At the time of the interview, participants in the University Cannabis sample were provided once again with the information sheet stating that the research was both voluntary and confidential, and were asked to sign a consent form after the details of the research had been explained and any questions about the research had been answered (See Appendix II). Participants were also informed of the limits of confidentiality surrounding harm to self or others. Individuals who agreed to take part in the research were administered a brief demographic questionnaire, and the neuropsychological tests as outlined previously. The demographic questionnaire collected information on education level, previous substance use, head injuries, and overdoses (See Appendix III).

The neuropsychological tests were administered in a fixed sequence by the researcher as listed below.

Wechsler Memory Scale III – Abbreviated (WMS-III-A) (Logical Memory I & Family Pictures I)
Trail Making Test (TMT)
Stroop Color and Word Test
Wisconsin Card Sorting Test – Abbreviated (WCST-A)
Wechsler Memory Scale III – Abbreviated (WMS-III-A) (Logical Memory II & Family Pictures II)

All interviews were conducted on a one on one basis in a room within the Psychology Department at the University of Waikato. As required by the Ethics Committee, at the completion of the research participants were provided with a list of drug and alcohol agencies and mental health services should they have any questions, or wish to obtain assistance with any of the issues discussed in the research (See Appendix IV).

Scoring and data entry

Scoring and data entry was identical to *Experiment 1*. For further details please see the *Procedure* section of *Experiment 1*.

RESULTS

A sample of 39 university students who used alcohol regularly (at least once weekly) were recruited from undergraduate and graduate courses at the University of Waikato. An additional sample of six university students who reported regular cannabis use (at least once weekly) were also recruited from undergraduate and graduate courses at the University of Waikato.

As can be seen in Table 2.1, the participants in the University Alcohol sample had a mean age of 23.41 years, were predominately female and had completed the equivalent of 7th Form or Year 13. Close to half of the sample were New Zealand European/Pakeha, followed by Other European, Maori, Maori/European, and Other which included English Fijian, African and European/Nuean.

The participants in the University Cannabis sample had a mean age of 20.5 years, were predominately male, and had completed the equivalent of 14 years of education (which is equivalent to one year of tertiary training). The participants in the University Cannabis sample were predominantly of New Zealand European descent.

Table 2.1

Demographic details of University Alcohol & University Cannabis samples

	Regular Alcohol Use Sample		Cannabis Use Sample	
Age	23.41	SD 7.33, Range 17-52	20.5	SD 1.517, Range 18-22
Gender				
Male	10	25.6	5	83.3%
Female	29	74.4	1	16.7%
Handedness				
Left	2	5.1	1	16.7%
Right	37	94.9	5	83.3%
Education	13.38 years	SD 1.50, Range 11-17	14.17 years	SD 1.17, Range 13-16
Ethnicity				
NZ European	18	46.15	5	83.3%
Maori	7	17.95		
Maori/European	4	10.26		
Other European	7	17.95	1	16.7%
Other	3	7.69		

An independent samples t-test showed that the two samples differed significantly in age ($t = -2.194$, $df = 43$, $p < 0.05$), but not in years of education ($t = 1.219$, $df = 43$, $p > 0.05$). A chi squared test showed that gender was related to sample membership ($\chi^2 = 7.788$, $p < 0.05$), while ethnicity ($\chi^2 = 3.565$, $p > 0.05$) was not related to sample membership.

Performance on the psychometric tests

Prior to any analysis, Shapiro-Wilks tests were conducted to assess the distribution of the data for normality. Using this test, the distribution of scores from the following measures were found to be significantly different from normal for the University Alcohol sample: WMS Logical Memory Score I ($W = 0.94$, $df = 39$), WMS Immediate Memory Index ($W = 0.93$, $df = 39$), WIAT Word Reading ($W = 0.91$, $df = 36$), Trail Making Part A Percentile ($W = 0.93$, $df = 39$) and Part B Percentile Score ($W = 0.88$, $df = 39$), Beck Anxiety Inventory Score ($W = 0.93$, $df = 36$), Beck Depression Inventory ($W = 0.90$, $df = 36$), WCST Total Number of Errors, ($W = 0.93$, $df = 38$) WCST Conceptual Level Responses ($W = 0.92$, $df = 38$) (all at $p < 0.05$). Square-root and inverse square root transformations normalised the distribution of the scores for the following measures: BAI, BDI-II, and WCST-A Standard Total Number of Errors and Conceptual Level Response. However, transformations did not normalise the distribution of the data for the WMS Logical Memory Score I, WMS Immediate Memory Index, WIAT Word Reading, Trail Making Part A Percentile and Part B Percentile Score. Obtained scores for the University Cannabis sample were shown to adhere to a normal distribution for all measures.

Where applicable, the normative population scores were transformed in the same way as the data to allow for comparison using a one-sample t-test. Data that were not normalised by transformation were compared using the standard t-test. One sample t-tests were then conducted to compare this sample to the published norms for each measure.

The one sample t-tests showed significant differences between the obtained and normative data for a number of measures for both samples. As shown in Table 2.2, significant differences were found between the University Alcohol sample and the normative data on all measures of the WIAT-II-A, Trail Making Test Part A, all NART measures (Verbal, Performance, Full Scale), and on the Stroop Color-Word

and Stroop Interference measures. Significant differences between the obtained and normative data were found on the Beck Depression Inventory-II, and on the WCST-A Standard Total Number of Errors and Conceptual Level Response also. Medium effects sizes were obtained when using Cohen's *d* for the WIAT-II-A Word Reading and Spelling subtests, and NART-II Performance IQ, while large effect sizes were obtained for the NART-II Full Scale and Verbal IQ scores. While large effect sizes are recommended as the standard effect size to report (Cohen, 1992), both medium and large effect sizes have been reported in the current study due to the relatively small sample size. The University Alcohol sample mean scores were higher than the normative data for all of these measures, with the exception of the WIAT-II-A Numerical Operations subtest. Scores for all other measures were not significantly different from the normative sample.

The one sample t-tests for the University Cannabis sample, as shown in Table 2.3, showed statistically significant differences compared to the normative mean for the Stroop Interference T-Score (significantly higher than the normative mean) and all measures of the WCST-A (significantly lower than the normative mean). Medium effect sizes were obtained on the WMS-III-A Logical Memory II, and TMT Part A Percentile Score, while large effect sizes were obtained on all of the WCST-A measures. Performance on all other measures was not significantly different from the normative sample at $p < 0.05$.

Given that the University Alcohol and University Cannabis sample's scores differed from the normative means on several measures, the results were compared to the standard deviation ranges provided for each measure to assess where the obtained results fell in regards to the normative mean. The mean scores for the University Alcohol sample fell within one standard deviation of the test norm on all measures. Mean scores on the Beck Anxiety Inventory for the University Alcohol sample fell within the mild range and scores on the Beck Depression Inventory-II fell within the minimal range. A summary of the mean and standard deviation scores for each measure is provided in Table 2.4. As mentioned previously, higher scores indicated better performance on all measures, with the exception of the BAI and BDI-II on which higher scores indicated increased symptomlogy.

Similarly, the results obtained for the University Cannabis sample fell within one standard deviation of the normative mean on most measures, with the exception of the Stroop Interference T-Score, which was one standard deviation higher than the

normative mean, and the WCST-A Conceptual Level Response, score which was one standard deviation lower than the normative mean. A summary of the mean and standard deviation scores is provided in Table 2.5.

Relation between demographic and psychometric test results

As discussed in *Experiment 1*, it has been suggested that psychometric tests may be influenced by various factors including anxiety and depression, age, years of education, handedness and gender. As in *Experiment* 1, correlations were calculated to examine these relations further.

As shown in Table 2.6, there was a significant positive correlation for the University Alcohol sample between the Beck Anxiety Inventory and the Beck Depression Inventory-II. Anxiety and depression did not appear to relate to the scores obtained on any of the other measures. As such, anxiety and depression were not included as covariates in any further analysis.

With regard to gender, there was a significant correlation with the Stroop Interference T-score (females scored higher) in the University Alcohol sample. There were no significant correlations between age, years of education, or handedness and the administered psychometric measures.

Due to the small sample size, correlations were not conducted with the University Cannabis sample to assess the effects of age, years of education, handedness or gender.

The relation between frequency of use and psychometric results

The relation between frequency of alcohol and cannabis use was assessed in both samples using Pearson Correlations. Frequency of alcohol use in the University Alcohol sample ranged from once weekly to daily, with the mean number of days of alcohol consumption per week being 1.90 (SD 1.25). Frequency of cannabis use in the Cannabis sample ranged from three times weekly to daily, with the mean number of days of cannabis use per week being 6.00 (SD 1.67).

As shown in Table 2.7, frequency of alcohol use was found to positively correlate with all measures from the NART-II (increased use associated with higher scores) and to negatively correlate with the WCST-A Total Number of Errors and Conceptual Level Responses (increased use associated with lower scores) in the University Alcohol sample. As shown in Table 2.8, frequency of cannabis use was

found to negatively correlate with the WMS-III-A Delayed Memory and Total Memory scores (increased use associated with lower scores), and positively correlate with the Stroop Word T-Score and Stroop Colour-Word T-Score (increased use associated with higher scores) in the University Cannabis sample.

Group Comparisons

In order to examine the effects of regular alcohol and regular cannabis use, comparisons were made between the University Control sample (described in *Experiment 1*), the University Alcohol, and the University Cannabis samples. Independent sample t-tests were used to compare the samples on measures that were normally distributed (as mentioned earlier). The data for the remaining measures, which were not normally distributed, were compared using the non-parametric equivalent to the independent samples t-test, the Mann-Whitney U test.

An independent samples t-test showed that the University Control sample and the University Alcohol sample did not differ significantly in age ($t = 0.589$, $df = 84$, $p > 0.05$) or years of education ($t = 0.941$, $df = 84$, $p > 0.05$). A chi squared test results showed that gender ($\chi^2 = 1.552$, $p > 0.05$) and ethnicity ($\chi^2 = 4.224$, $p > 0.05$) were not related to sample membership.

Similarly, an independent samples t-test showed that the University Control sample and the University Cannabis sample did not differ significantly in age ($t = 2.679$, $df = 51$, $P > 0.05$) or years of education ($t = -0.804$, $df = 51$, $p > 0.05$). Chi squared analyses showed that gender was related to sample membership ($\chi^2 = 14.229$, $p < 0.05$), and ethnicity was not related to sample membership ($\chi^2 = 3.551$, $p > 0.05$).

As shown in Table 2.9 and Table 2.10, the University Control sample and the University Alcohol sample did not differ significantly on any of the administered measures. Medium effect sizes were obtained on the WMS-III-A Family Pictures I subtest. Table 2.11 and Table 2.12 show that the University Control sample differed significantly from the University Cannabis sample on the WCST-A Perseverative Responses and Perseverative Errors, as well as on the WCST-A Total Number of Errors. Medium effect sizes using Cohen's *d* were obtained on the WCST-A Perseverative Responses and Perseverative Errors. On all of these measures, the University Control sample obtained higher scores. The University Control and University Cannabis samples did not significantly differ on any other measures.

As shown in Table 2.13 and Table 2.14, the University Alcohol sample differed significantly from the University Cannabis sample on the Stroop Interference T-Score, and all measures of the WCST-A. Medium effect sizes were obtained on the all measures of the WCST-A. On the Stroop Interference T-Score, the University Cannabis sample obtained higher scores, while on the WCST-A the University Cannabis sample obtained lower scores.

TABLE 2.2

One sample t-test comparing University Alcohol Sample to Normative Data, including means, standard deviations, and Cohen's d

	Normative		University Alcohol					Cohens
	Mean	SD	Mean	SD	t	df	Significance	*d*
WMS Logical Memory I	10	3	10.00	2.40	0.00	38	NS	0.00
WMS Family Pictures I	10	3	9.54	2.60	-1.11	38	NS	-0.15
WMS Logical Memory II	10	3	10.54	2.49	1.35	38	NS	0.18
WMS Family Pictures II	10	3	9.28	2.36	-1.90	38	NS	-0.24
WMS Immediate Memory	100	15	98.18	11.47	-0.99	38	NS	-0.12
WMS Delayed Memory	100	15	100.44	10.50	0.26	38	NS	0.03
WMS Total Memory	100	15	98.49	11.19	-0.84	38	NS	-0.10
WIAT Word Reading	100	15	107.94	7.50	6.36	35	*	0.53
WIAT Numerical Operations	100	15	94.94	12.44	-2.44	35	*	-0.34
WIAT Spelling	100	15	110.86	8.93	7.30	35	*	0.72
WIAT Composite	100	15	104.11	9.25	2.67	35	*	0.27
TMT Part A Percentile	50	16	58.87	25.08	2.21	38	*	0.26
TMT Part B Percentile	50	16	46.87	30.81	-0.63	38	NS	-0.09
Stroop Word T-Score	50	10	49.71	10.90	-0.16	37	NS	-0.03
Stroop Colour T-Score	50	10	46.89	9.68	-1.98	37	NS	-0.31
Stroop Colour-Word T-Score	50	10	53.39	6.79	3.08	37	*	0.34
Stroop Interference T-Score	50	10	54.58	6.13	4.60	37	*	0.46
NART Full Scale IQ	100	15	112.64	4.22	17.96	35	*	0.84
NART Verbal IQ	100	15	112.28	4.76	15.47	35	*	0.82
NART Performance IQ	100	15	111.75	3.36	20.99	35	*	0.78
Beck Anxiety Inventory	3.33	3.02	3.24	2.71	-1.53	35	NS	-0.03
Beck Depression Inventory	3.54	3.15	3.04	2.78	-3.60	35	*	-0.16
WCST Total Number of Errors	10	3.87	10.05	3.84	21.50	37	*	0.01
WCST Perseverative Responses	100	15	100.50	14.03	0.22	37	NS	0.03
WCST Perseverative Errors	100	15	98.55	12.72	-0.70	37	NS	-0.10
WCST Nonperseverative Errors	100	15	103.00	16.76	1.10	37	NS	0.20
WCST Conceptual Level Responses	10	3.87	9.94	4.06	-19.45	37	*	-0.02

* Significant at $p < 0.05$

TABLE 2.3

One sample t-test comparing University Cannabis Sample to Normative Data, including means, standard deviations and Cohen's d

	Normative		University Cannabis					Cohens
	Mean	SD	Mean	SD	t	df	Significance	*d*
WMS Logical Memory I	10.00	3	10.50	1.76	0.70	5	NS	0.17
WMS Family Pictures I	10.00	3	9.33	1.97	-0.83	5	NS	-0.22
WMS Logical Memory II	10.00	3	11.50	2.35	1.57	5	NS	0.50
WMS Family Pictures II	10.00	3	9.00	1.67	-1.46	5	NS	-0.33
WMS Immediate Memory	100.00	15	99.00	8.41	-0.29	5	NS	-0.07
WMS Delayed Memory	100.00	15	102.00	9.36	0.52	5	NS	0.13
WMS Total Memory	100.00	15	99.67	9.00	-0.09	5	NS	-0.02
TMT Part A Percentile	50.00	16th	68th	22.75	1.88	5	NS	0.51
TMT Part B Percentile	50.00	16th	55th	36.91	0.30	5	NS	0.13
Stroop Word T-Score	50.00	10	48.67	13.85	-0.24	5	NS	-0.13
Stroop Colour T-Score	50.00	10	50.67	7.99	0.20	5	NS	0.07
Stroop Colour-Word T-Score	50.00	10	54.50	11.19	0.99	5	NS	0.45
Stroop Interference T-Score	50.00	10	60.33	8.04	3.15	5	*	1.03
WCST Total No Errors	100.00	15	85.67	9.71	-3.62	5	*	-0.96
WCST Perseverative Responses	100.00	15	87.50	7.66	-4.00	5	*	-0.83
WCST Persevertive Errors	100.00	15	86.17	8.89	-3.81	5	*	-0.92
WCST Nonperseverative Errors	100.00	15	87.33	10.01	-3.10	5	*	-0.84
WCST Conceptual Level Response	100.00	15	84.83	10.98	-3.38	5	*	-1.01

* Significant at $p < 0.05$

TABLE 2.4

Means and Standard Deviations for Normative and University Alcohol Sample

	Normative		University Regular Use	
	Mean	SD	Mean	SD
WMS Logical Memory I	10	3	10.00	2.40
WMS Family Pictures I	10	3	9.54	2.60
WMS Logical Memory II	10	3	10.54	2.49
WMS Family Pictures II	10	3	9.28	2.36
WMS Immediate Memory	100	15	98.18	11.47
WMS Delayed Memory	100	15	100.44	10.50
WMS Total Memory	100	15	98.49	11.19
WIAT Word Reading	100	15	107.94	7.50
WIAT Numerical Operations	100	15	94.94	12.44
WIAT Spelling	100	15	110.86	8.93
WIAT Composite	100	15	104.11	9.25
TMT Part A Percentile	50th	16th	59th	25.08
TMT Part B Percentile	50th	16th	47th	30.81
Stroop Word T-Score	50	10	49.71	10.90
Stroop Colour T-Score	50	10	46.89	9.68
Stroop Colour-Word T-Score	50	10	53.39	6.79
Stroop Interference T-Score	50	10	54.58	6.13
NART Full Scale IQ	100	15	112.64	4.22
NART Verbal IQ	100	15	112.28	4.76
NART Performance IQ	100	15	111.75	3.36
Beck Anxiety Inventory	11.08	9.10	10.53	7.36
Beck Depression Inventory	12.56	9.93	9.22	7.72
WCST Total Number of Errors	100	15	101.08	14.76
WCST Perseverative Responses	100	15	100.50	14.03
WCST Perseverative Errors	100	15	98.55	12.72
WCST Nonperseverative Errors	100	15	103.00	16.76
WCST Conceptual Level Responses	100	15	98.71	16.48

TMT results are presented in percentile scores. 1 SD below the 50th percentile is the 16th percentile

TABLE 2.5

Means and Standard Deviations for Normative and University Cannabis Samples

	Normative		University Cannabis	
	Mean	SD	Mean	SD
WMS Logical Memory I	10	3	10.50	1.76
WMS Family Pictures I	10	3	9.33	1.97
WMS Logical Memory II	10	3	11.50	2.35
WMS Family Pictures II	10	3	9.00	1.67
WMS Immediate Memory	100	15	99.00	8.41
WMS Delayed Memory	100	15	102.00	9.36
WMS Total Memory	100	15	99.67	9.00
TMT Part A Percentile	50th	16th	68th	22.75
TMT Part B Percentile	50th	16th	55th	36.91
Stroop Word T-Score	50	10	48.67	13.85
Stroop Colour T-Score	50	10	50.67	7.99
Stroop Colour-Word T-Score	50	10	54.50	11.19
Stroop Interference T-Score	50	10	60.33	8.04
WCST Total No Errors	100	15	85.67	9.71
WCST Perseverative Responses	100	15	87.50	7.66
WCST Persevertive Errors	100	15	86.17	8.89
WCST Nonperseverative Errors	100	15	87.33	10.01
WCST Conceptual Level Response	100	15	84.83	10.98

TMT results are presented in percentile scores. 1 SD below the 50th percentile is the 16th percentile

Table 2.6

Correlations between demographic and psychometric test results for the University Alcohol Sample

	Correlation Coeffient (r)					
	Pearsons	Point Biserial	Point Biserial	Pearsons	Pearsons	Pearsons
	Age	Gender	Handedness	Years of Education	Beck Anxiety	Beck Depression
WMS Logical Memory I		0.025		-0.125	116.000	0.006
WMS Family Pictures I		0.105		-0.233	-0.036	0.005
WMS Logical Memory II		-0.153		-0.136	0.049	0.008
WMS Family Pictures II		0.231		-0.021	-0.013	-0.004
WMS Immediate Memory		0.089		-0.021	0.047	0.027
WMS Delayed Memory		0.032		-0.228	0.029	0.002
WMS Total Memory		0.075		-0.225	0.040	0.021
WIAT Word Reading		0.213			0.148	0.026
WIAT Numerical Operations		0.181			0.073	0.085
WIAT Spelling		-0.035			0.013	-0.001
WIAT Composite		0.148			0.121	0.052
TMT Part A Percentile		0.292	0.154	-0.143	0.156	-0.004
TMT Part B Percentile		0.223	0.140	0.035	0.036	-0.088
Stroop Word T-Score		0.299			-0.031	-0.083
Stroop Colour T-Score		0.044			0.207	0.022
Stroop Colour-Word T-Score		-0.205			-0.086	-0.138
Stroop Interference T-Score		**-0.383***			-0.039	-0.018
NART Full Scale IQ	0.107	0.050			0.193	0.123
NART Verbal IQ	0.097	0.061			0.207	0.128
NART Performance IQ	0.070	0.063			0.186	0.123
Beck Anxiety Inventory		0.020				**0.656***
Beck Depression Inventory		-0.177			**0.656***	
WCST Total Number of Errors		0.259			-0.252	-0.136
WCST Perseverative Responses		0.311			-0.281	-0.174
WCST Perseverative Errors		0.236			-0.258	-0.146
WCST Nonperseverative Errors		0.173			-0.128	-0.287
WCST Conceptual Level Responses		0.305			-0.020	-0.033

* Significant at $p < 0.05$

Table 2.7

Correlations between frequency of alcohol use and psychometric test results for the University Alcohol Sample

	Correlation Coeffient (r)
	Pearsons
	Frequency of Use
WMS Logical Memory I	-0.105
WMS Family Pictures I	-0.209
WMS Logical Memory II	-0.058
WMS Family Pictures II	-0.212
WMS Immediate Memory	-0.187
WMS Delayed Memory	-0.163
WMS Total Memory	-0.177
WIAT Word Reading	-0.255
WIAT Numerical Operations	-0.048
WIAT Spelling	0.116
WIAT Composite	0.097
TMT Part A Percentile	-0.081
TMT Part B Percentile	-0.298
Stroop Word T-Score	0.051
Stroop Colour T-Score	0.030
Stroop Colour-Word T-Score	-0.059
Stroop Interference T-Score	-0.162
NART Full Scale IQ	**0.362***
NART Verbal IQ	**0.342***
NART Performance IQ	**0.332***
Beck Anxiety Inventory	0.218
Beck Depression Inventory	0.000
WCST Total Number of Errors	**-0.472***
WCST Perseverative Responses	-0.192
WCST Perseverative Errors	-0.248
WCST Nonperseverative Errors	-0.054
WCST Conceptual Level Responses	**-0.474***

* Significant at $p < 0.05$

Table 2.8

Correlations between frequency of cannabis use and psychometric test results for the University Cannabis Sample

	Correlation Coeffient (r)
	Pearsons
	Frequency of Use
WMS Logical Memory I	0.131
WMS Family Pictures I	-0.517
WMS Logical Memory II	-0.784
WMS Family Pictures II	-0.536
WMS Immediate Memory	-0.789
WMS Delayed Memory	**-0.844***
WMS Total Memory	**-0.834***
TMT Part A Percentile	-0.030
TMT Part B Percentile	-2.259
Stroop Word T-Score	**0.896***
Stroop Colour T-Score	0.779
Stroop Colour-Word T-Score	**0.838***
Stroop Interference T-Score	0.253
WCST Total Number of Errors	0.210
WCST Perseverative Responses	0.029
WCST Persevertive Errors	0.130
WCST Nonperseverative Errors	-0.505
WCST Conceptual Level Responses	-0.089

* Significant at $p < 0.05$

Table 2.9

Independent Samples t-test Comparing University Control and University Alcohol Samples, including means, standard deviations and Cohen's d

	University Control		University Alcohol		t	df	Significance	Cohens
	Mean	SD	Mean	SD				*d*
WMS Logical Memory 2	10.47	3.01	10.54	2.49	0.33	84.00	NS	-0.03
WMS Family Pictures 2	10.19	3.21	9.28	2.36	1.18	84.00	NS	0.32
WMS Delayed Memory	104.77	15.27	100.44	10.50	1.13	83.00	NS	0.33
WMS Total Memory	102.70	15.10	98.49	11.19	1.13	83.00	NS	0.31
WIAT Numerical Operations	100.30	15.10	94.94	12.44	1.54	78.00	NS	0.38
WIAT Spelling	114.14	9.69	110.86	8.93	1.42	78.00	NS	0.35
WIAT Composite	108.66	10.96	104.11	9.25	1.98	78.00	NS	0.44
Stroop Word T-Score	52.16	9.82	49.71	10.90	0.92	82.00	NS	0.24
Stroop Colour-Word T-Score	54.60	9.38	53.39	6.79	0.35	82.00	NS	0.15
Stroop Interference T-Score	54.16	7.66	54.58	6.13	-0.43	82.00	NS	-0.06
NART Full Scale IQ	113.51	5.70	112.64	4.22	0.90	79.00	NS	0.17
NART Verbal IQ	112.60	3.95	112.28	4.76	0.96	79.00	NS	0.07
NART Performance IQ	113.70	5.09	111.75	3.36	0.90	79.00	NS	0.44
WCST Perseverative Responses	98.77	11.43	100.50	14.03	0.68	81.00	NS	-0.14
WCST Perseverative Errors	97.60	12.01	98.55	12.72	0.44	81.00	NS	-0.08
WCST Nonperseverative Errors	100.35	17.03	103.00	16.76	0.80	81.00	NS	-0.16

* Signficant at $p < 0.05$

Table 2.10

Mann-Whitney U Test Comparing University Control and University Alcohol Samples, including Cohen's d

	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig	Cohens *d*
WMS Logical Memory 1	875.50	1655.50	-0.36	NS	0.13
WMS Family Pictures I	793.00	1573.00	-1.08	NS	0.53
WMS Immediate Memory	770.50	1550.50	-1.27	NS	0.30
WIAT Word Reading	742.50	1408.50	-0.48	NS	0.16
TMTAPercentile	865.00	1993.00	-0.45	NS	-0.19
TMTBPercentile	884.00	1664.00	-0.28	NS	0.19
Stroop Colour T-Score	696.00	1437.00	-1.60	NS	0.24
Beck Anxiety Inventory	729.00	1764.00	-0.77	NS	0.12
Beck Depression Inventory	780.00	1815.00	-0.29	NS	-0.09
WCST Total Number of Errors	819.50	1854.50	-0.32	NS	-0.10
WCST Conceptual Level Responses	777.50	1812.50	-0.71	NS	-0.13

* Signficant at $p < 0.05$

Table 2.11

Independent Samples t-test Comparing University Control and University Cannabis Samples, including means, standard deviations and Cohen's d

	University Control		University Cannabis		t	df	Significance	Cohens
	Mean	SD	Mean	SD				*d*
WMS Logical Memory 1	10.33	2.68	10.50	1.76	-0.24	51	NS	0.02
WMS Logical Memory 2	10.47	3.01	11.50	2.35	-0.60	50	NS	0.12
WMS Family Pictures 2	10.19	3.21	9.00	1.67	0.74	50	NS	-0.13
WMS Immediate Memory	102.26	14.89	99.00	8.41	0.39	51	NS	-0.11
WMS Delayed Memory	104.77	15.27	102.00	9.36	0.25	50	NS	-0.10
WMS Total Memory	102.70	15.10	99.67	9.00	0.32	50	NS	-0.11
TMT Part B Percentile	52.91	31.87	54.50	36.91	-0.26	51	NS	-0.44
Stroop Word T-Score	52.16	9.82	50.67	7.99	0.69	50	NS	-0.20
Stroop Colour-Word T-Score	54.60	9.38	54.50	11.19	-0.11	50	NS	-0.01
Stroop Interference T-Score	54.16	7.66	60.33	8.04	-1.96	50	NS	0.39
WCST Perservation Responses	98.77	11.43	87.50	7.66	2.27	49	*	-0.50
WCST Perservation Errors	97.60	12.01	86.17	8.89	2.16	49	*	-0.50
WCST Nonperservation Errors	100.35	17.03	87.33	10.01	1.81	49	NS	-0.42

* Significant at $p < 0.05$

Table 2.12

Mann-Whitney U Test Comparing University Control and University Cannabis Samples, including Cohen's d

	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig	Cohens *d*
WMS Family Pictures I	114.50	135.50	-0.75	NS	-0.21
TMT Part A Percentile Score	109.50	1237.50	-0.89	NS	0.35
Stroop Colour T-Score	133.50	1214.50	-0.13	NS	-0.20
WCST Total No Errors	67.50	88.50	-1.98	*	-0.45
WCST Conceptual Level Response	80.00	101.00	-1.61	NS	-0.40

* Significant at p< 0.05

Table 2.13

Independent Samples t-test Comparing University Alcohol and University Cannabis Samples, including means, standard deviations and Cohen's d

	University Alcohol		University Cannabis		t	df	Significance	Cohens
	Mean	SD	Mean	SD				*d*
WMS Family Pictures 1	9.54	2.60	9.33	1.97	0.18	43	NS	0.03
WMS Logical Memory 2	10.54	2.49	11.50	2.35	-0.89	43	NS	-0.15
WMS Family Pictures 2	9.28	2.36	9.00	1.67	0.28	43	NS	0.04
WMS Delayed Memory	100.44	10.50	102.00	9.36	-0.34	43	NS	-0.08
WMS Total Memory	98.49	11.19	99.67	9.00	-0.25	43	NS	-0.06
Stroop Word T-Score	49.71	10.90	48.67	13.85	0.21	42	NS	0.06
Stroop Colour-Word T-Score	53.39	6.79	54.50	11.19	-0.34	42	NS	-0.09
Stroop Interference T-Score	54.58	6.13	60.33	8.04	-2.05	42	*	-0.48
WCST Perservation Responses	100.50	14.03	87.50	7.66	2.20	42	*	0.51
WCST Perservation Errors	98.55	12.72	86.17	8.89	2.29	42	*	0.56
WCST Nonperservation Errors	103.00	16.76	87.33	10.01	2.21	42	*	0.56

* Significant at p< 0.05

Table 2.14

Mann-Whitney U Test Comparing University Alcohol and University Cannabis Samples, including Cohen's d

	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig	Cohens *d*
WMS Logical Memory I	108.50	888.50	-0.29	NS	-0.08
WMS Immediate Memory	114.00	894.00	-0.10	NS	-0.04
TMT Part A Percentile Score	97.50	877.50	-0.65	NS	-0.27
TMT Part B Percentile Score	104.00	884.00	-0.44	NS	-0.24
Stroop Colour T-Score	88.00	829.00	-0.89	NS	-0.21
WCST Standard Total No Errors	43.50	64.50	-2.41	*	0.62
WCST Standard Score for Conceptual Level Response	49.50	70.50	-2.21	*	0.52

* Significant at $p < 0.05$

DISCUSSION

The present study was conducted to assess the effects of regular alcohol and cannabis use on the cognitive functioning of a sample of university students. As outlined in the *Results* section, overall findings showed that the University Alcohol sample obtained scores similar to the normative means, and in several cases, obtained scores better than the normative means. In particular, the University Alcohol sample obtained higher scores on all measures of the WIAT-II-A with the exception of Numerical Operations, the Trail Making Test Part A, all NART-II measures, and the Stroop Color-Word and Stroop Interference measures. The University Cannabis sample obtained higher scores on the Stroop Interference T-Score and lower scores on all measures of the WCST-A compared to the normative data. Results for the University Cannabis sample on all other measures were similar to the normative means.

When compared to the University Control sample from *Experiment 1*, the University Alcohol sample did not differ significantly on the psychometric measures, however, the University Cannabis sample scored lower on the WCST-A Perseverative Responses and Perseverative Errors, as well as on the WCST-A Total Number of Errors. Comparing the University Alcohol and University Cannabis samples showed that the University Alcohol sample obtained higher scores on all measures of the WCST-A than the University Cannabis sample, however, the University Alcohol sample obtained significantly lower Stroop Interference T-Scores than were obtained by the University Cannabis sample.

These findings are discussion further below.

Wechsler Memory Scale-III-Abbreviated

No impairments in memory functioning were found for either the University Alcohol sample or the University Cannabis sample in the current study, although a medium effect size was found on the WMS-III-A Logical Memory II subtest when comparing the University Cannabis sample to the normative mean. Neither sample differed from the University Control sample. Thus the measures of short- and long-term memory for both samples were within the normative range, indicating there was no impairment in the short- or long-term verbal and visual memory of either sample.

This suggests that neither of the samples would have difficulty remembering information in their daily lives, as mean scores on these measures were not more than one standard deviation below the normative mean (Wechsler, 2002).

These findings for the University Alcohol sample contrast with those reported by Weissenborn and Duka (2000, 2003) who found that acutely intoxicated adolescents with a history of alcohol use had impairments in short-term memory. However, the results of the present study are similar to those reported by Moss, Kirisci, Gordon and Tarter (1994) and Eckardt, Stapleton, Rawlings, Davis and Grodin (1995). The findings for the alcohol sample in this study are likely to have differed from those reported by Weissenborn and Duka (2000, 2003), as while the current sample had a history of alcohol use, they were not acutely intoxicated at the time of the assessment.

The scores of the University Cannabis sample on the WMS-III-A, while not significantly different from the other university samples, were found to be associated with frequency of cannabis use. Results showed that participants with a greater frequency of cannabis use obtained lower scores on the WMS-III-A Delayed Memory and Total Memory scores. This finding suggests that more frequent cannabis use may result in increased memory impairments as has been reported in the literature previously (Pope Jr. & Yurgelun-Todd, 1996; Schwartz, Gruenewald, Klitzner, & Fedio, 1989).

The findings from the current studies suggest that while casual alcohol use in university students is not associated with impairments in memory, increased frequency of cannabis use is associated with increased impairments in long-term memory and overall memory functioning. The noted low scores for the cannabis sample suggests that university students with regular and frequent cannabis use may have difficulty remembering information in their daily functioning, and this is likely to negatively impact on their academic studies (Fergusson, Horwood, & Beautrais, 2003; Lynskey & Hall, 2000).

Wisconsin Card Sorting Test-Abbreviated

In the current study, the University Alcohol sample obtained results in the normal range, however, increased frequency of use was associated with lower scores on the WCST-A Total Number of Errors and Conceptual Level Responses.

The overall findings for the University Alcohol sample contrast with the impairments reported by Hannon, Day, Butler, Larson and Casey (1983) on the WCST in a sample of acutely intoxicated adolescents with a history of alcohol use; and also differ from those reported by Moss, Kirisci, Gordon and Tarter (1994) who reported poor performance in female adolescents, although concur with the unimpaired performance in male adolescents that was reported in this same study. The findings regarding the association between increased frequency of use and scores on the WCST-A Total Number of Errors and Conceptual Level Responses are similar to those reported by Hannon, Day, Butler, Larson and Casey (1983), who reported an association between increased use and poorer performance on the WCST Nonperseverative Errors measure.

The results of the current alcohol sample may differ from those reported by Hannon, Day, Butler, Larson and Casey (1983) as the current sample was not acutely intoxicated at the time of assessment, and may have differed in regards to drinking history. Similarly, the University Alcohol sample may have differed from that reported on by Moss, Kirisci, Gordon and Tarter (1994) as the current sample consisted of university students who were not assessed for alcohol dependence, and therefore the amount and frequency with which they were consuming alcohol may not be comparable.

The University Cannabis sample obtained lower scores than the normative mean on all of the WCST-A measures, however, obtained results were within one standard deviation of the normative mean on most measures. The one exception to this were the scores on the WCST-A Conceptual Level Response which were one standard deviation lower than the normative mean on average. As scores on the Conceptual Level Responses are said to indicate the individuals understanding of the correct sorting principles (Lezak, Howieson, Loring, Hannay, & Fisher, 2004; Strauss, Sherman, & Spreen, 2006), this finding suggests that the University Cannabis sample has difficulty identify ways to solve a problem. As this results is more that one standard deviation below the normative mean, this finding represents a clinically significant impairment, and may impact on their ability to cope with problems in their daily lives. The findings for the University Cannabis sample are similar to Pope Jr. and Yurgelun-Todd (1996) who found impairment on the preservative measures in university students with heavy cannabis use, although the same impairments were not found in light cannabis users.

Overall, the findings on the WCST-A suggest that casual alcohol use is not associated with impairments in problem solving ability, however increased frequency of use is associated with an increase in errors on problem solving tasks, and difficulty continuing with a problem solving strategy. This suggests that increased alcohol use in university students is associated with poorer problem solving skills. Overall findings for the cannabis sample suggest that university students who use cannabis have difficulty identifying ways in which to solve a problem, and this may impact on their ability to cope with problems in their daily lives (Kongs, Thompson, Iverson, & Heaton, 2000).

Trail Making Test

In the current study, neither the University Alcohol sample nor the University Cannabis sample, were found to have poorer scores on the TMT compared to the normative data. These findings suggest that the two samples are unlikely to have difficulties with simple attention (as measured by the TMT Part A), or with divided attention and cognitive flexibility (as measures by the TMT Part B).

The findings for the University Alcohol sample concur with the literature, which have reported results comparable to the normative data in individuals with a short history of alcohol use (Eckardt, Stapleton, Rawlings, Davis, & Grodin, 1995). The findings for the University Cannabis sample are similar to those that have been reported previously on the cognitive functioning of young cannabis users when assessed with the TMT (Carlin & Trupin, 1977; Schaeffer, Andrysiak, & Ungerleider, 1981). Interestingly, the findings for the University Cannabis sample on the TMT contrast with the poorer scores obtained on the WCST-A, another measure said to assess cognitive flexibility. The difference in the results from these two measures suggests that the TMT and the WCST-A measure different aspects of cognitive flexibility. Previous research has also suggests that these two measures may measure different aspects of functioning, with the TMT said to be more sensitive to impairments in cognitive flexibility (Strauss, Sherman, & Spreen, 2006). Given the different findings on these two measures, future research may be better to use the TMT to assess cognitive flexibility, while using the WCST-A to measure problem solving specifically.

Stroop Colour Word Test

In the current study, the University Alcohol sample performed at a similar level to the normative mean, while the University Cannabis sample performed better than the normative mean, on the Stroop Interference T-Score.

The findings for the University Alcohol sample are similar to those reported by Fadardi and Cox (2006), who administered the Stroop task to university students who identified as social drinkers. The findings for the University Cannabis sample are similar to those reported by Pope Jr. and Yurgelun-Todd (1996), however, the higher Stroop Interference T-Score in the current sample was unexpected. The Stroop Interference T-Score is derived from the word, colour and colour-word raw scores and is said to be a measure of an individual's ability to inhibit responses. Previous research has suggested that impairments in impulse control and inhibition are more likely in substance using populations (Verdejo-Garcia, Lopez-Torrecillas, Orozco, & Perez-Garia, 2004), but this was not seen for the current cannabis sample.

Similarly unexpected was the association shown between the Stroop Word T-Score and Stroop Colour-Word T-Score and frequency of cannabis use. This relation suggests that word reading ability improves with frequency of cannabis use. Previous research has suggested that learning is impaired in casual cannabis users (e.g. Pope Jr. & Yurgelun-Todd, 1996), however, the findings on the Stroop and WMS-III-A suggest that this is not the case in this cannabis sample. Further research is needed to examine this finding.

The findings for both samples indicate good cognitive flexibility and the ability to respond to task demands, and that casual use does not appear to affect impulse control and inhibition. The results on the Stroop task coincide with those obtained by the samples on the TMT which is also said to measure cognitive flexibility. This suggests that the two measures are likely to measure similar constructs.

National Adult Reading Test-II

The NART-II was used with only the University Alcohol sample. The University Alcohol sample obtained higher scores on all measures from the NART-II compared to the normative data. The scores were comparable to those obtained by the University Control sample. Findings did, however, suggest an association between frequency of use and NART-II scores, with higher frequency of alcohol use associated

with better scores. The correlation between these measures and frequency of alcohol use was, however, relatively small, and scores were only slightly above one standard deviation from the normative mean. This finding may however suggest that alcohol may be used as a coping mechanism in those with higher IQ, which has been previously reported in the literature (Batty, Deary, Schoon, Emslie, Hunt, & Gale, 2008). Overall, these results suggest that intellectual functioning was not impaired in the University Alcohol sample.

Wechsler Individual Achievement Test-Abbreviated

As with the NART-II, the WIAT-II-A was conducted with only the University Alcohol sample. On the WIAT-II-A, the University Alcohol sample results were comparable to the normative data, with the exception of the Numerical Operations subtest which was lower. This finding is somewhat unexpected given the high functioning of the sample in the word reading and spelling subtests, however, it is still within the normative standard deviation range for this test. The lower score on the Numerical Operation subtest may be a factor of the New Zealand education system in which mathematics education following 5th Form is not compulsory. In the current sample the effect of mathematics education on the obtained Numerical Operations score was unable to be determined as this was not assessed.

Overall, the findings on the WIAT-II-A suggest that regular alcohol use in university students is not associated with impairments in reading, spelling, or mathematical ability.

Beck Anxiety Inventory & Beck Depression Inventory-II

The BAI and BDI-II were conducted with only the University Alcohol sample. The University Alcohol sample completed the BAI and BDI-II to assess anxiety and depression respectively. Results on these measures suggested anxiety symptoms in the mild range, and in the minimal range for depression. The low occurrence of anxiety and depression symptoms in the University Alcohol sample are similar to those reported by a number of previous studies (Creamer, Foran, & Bell, 1995; Fisher, 1996; Gorenstein, Andrade, Filho, Tung, & Artes., 1999; Lam, Pepper, & Ryabchenko, 2004; Troup, 2001; Whisman, Pere, & Ramel, 2000; Wiebe & Penley, 2005).

The scores for the BAI and BDI-II for the University Alcohol sample were highly correlated, as has been reported previously in both clinical and non-clinical populations, including student samples (Gotlib, 1984). The correlation reported between the BAI and BDI-II was similar to that reported in the normative data (Beck & Steer, 1990) and is also similar to that reported by Troup (2001) who used these measures in a NZ university sample. This suggests that the two measures assess similar constructs, as has been reported previously (Beck & Steer, 1990; Beck, Steer, & Brown, 1996).

As discussed, the University Alcohol sample obtained scores similar to those reported in research both overseas and in New Zealand, and the results on these measures were not found to relate to the results obtained on any of the psychometric measures. As levels of anxiety and depression were low these were unlikely to have affected performance on other tests.

Limitations

The findings from the current study should be interpreted with caution for a number of reasons. Both samples were of individuals who reported consuming alcohol or cannabis at least once weekly (and therefore unlikely to be dependent); however, information on the amount consumed on each occasion was not obtained. This was because participants were generally unable to specify the amount consumed. The amount of alcohol and cannabis consumed by each participant on a regular basis was, therefore, unavailable, and may account for some of the findings which do not concur with the literature in this area.

Frequency of alcohol and cannabis use reported by participants may have also been an influencing factor in the current research, as individuals potentially under- or over-reported their use. In addition, individuals may not have reported on all substances they were using at the time of the interview. As the research was both voluntary and anonymous it was hoped that the likelihood of false reporting would be reduced, however, this cannot be determined.

As outlined, only six individuals were recruited for the University Cannabis sample over the period of January to December 2007. Therefore, extrapolation of data from this sample to the wider population is difficult, although previous studies have reported similar sample sizes (e.g. Carlin & Trupin, 1977; Jacobson, Mencl, Westerveld, & Pugh, 2004; Schaeffer, Andrysiak, & Ungerleider, 1981; Schwartz,

Gruenewald, Klitzner, & Fedio, 1989). The small cannabis sample could suggest that there are few cannabis using students at the University of Waikato. This, however, is unlikely, as the literature suggests that cannabis is the most commonly used illicit substance in New Zealand, and overseas studies have reported high rates of cannabis use in college and university populations (Smart & Ogborne, 2000; Webb, Ashton, Kelly, & Kamali, 1996). A more likely explanation for the small number of participants is the stigma that is associated with admitting substance use, and potential concerns around admitting to participation in an illegal activity (Sullivan, 2007). While the information was anonymised from all participants, other potential participants may have been concerned as to the dissemination of any information they provided, and, that this could potentially identify them to other individuals.

The current samples were recruited through only the Psychology Department at the University of Waikato. At the time of this research, the majority of students enrolled in psychology were female. As such, a larger percentage of the recruited participants in the alcohol sample were female. In contrast, the cannabis sample was largely males. Therefore, recruitment in other departments at the University may have been useful, although generally the university student population is female biased. Due to the high number of female participants, this may make the generalisation of these results difficult.

Recruitment for both samples may have been influenced by the limited reimbursement available to participants for their time (the researcher was only able to offer a small course credit to individuals in the first year psychology courses). This may have potentially limited the number of individuals who volunteered. Previous research has found that offering incentives, such as money, does increase participation in research (Edwards, Roberts, Clarke, DiGuiseppi, Pratap, Wentz, & Kwan, 2002; Festinger, Marlowe, Croft, Dugosh, Mastro, Lee, DeMatteo, & Patapis, 2005), although concerns have been raised regarding incentives as they could be considered as coercion to participate given some individual's continued drug seeking behaviour (Cunningham, 1998; Galanter & Kleber, 1999; McCrady & Bux Jr., 1999).

Overall Findings

The findings from the current study suggest that there are no significant impairments in the cognitive functioning of university students who consume alcohol regularly, although increased frequency of alcohol use was associated with decreased

problem solving ability. The findings for the University Cannabis sample suggest that poorer problem solving skills are more likely in university students who use cannabis regularly, and that difficulties in the cannabis sample are likely to represent clinically significant difficulties (noticeable impairments) in at least some aspects of problem solving ability. Additionally, increased frequency of cannabis use was shown to be associated with poorer performance in memory functioning. Poorer performance in these areas may be associated with noticeable deficits in daily functioning, and may negatively effect achievement at university in this population. Further research is needed to assess the cognitive functioning of university students who use substances and/or alcohol.

The findings from this study suggest that increased alcohol and cannabis use may be associated with poorer performance on several psychometric measures. This suggests that the administered psychometric measures are sensitive to the effects of alcohol and drug use even for casual users. In the next study these psychometric measures were administered to a sample of individuals on Methadone Maintenance Treatment at the Community Alcohol and Drug Service to assess the longer term effects of substance use.

EXPERIMENT 3

Following the completion of *Experiment 1*, and as discussed in the *Introduction* the aims of this experiment were to explore the cognitive deficits of a group of opiate dependent participants enrolled in MMT, and to assess the association between cognitive outcomes and adherence to treatment.

METHOD

Participants

In order to recruit participants for this study, the Community Alcohol & Drug Service (CADS) in Hamilton was approached, as this service provides treatment for over 200 individuals on Methadone Maintenance Treatment (MMT), and is the largest provider of methadone treatment in the Waikato region. The CADS management staff agreed to participate in the research, and staff were willing to assist in recruiting participants for the research. In order to increase the likelihood of individuals participating in the research, appointments to participate in the study were, where possible, scheduled in conjunction with existing appointments at the service.

Of approximately 220 individuals on MMT at the time of this study, 46 individuals agreed to be contacted. Of these, 2 declined to be interviewed, 22 did not arrive, and 7 were unable to be contacted. The final sample consisted of only 8 men and 7 women.

Of the sample interviewed, 12 identified as New Zealand European, 1 as New Zealand Maori and 2 as European of non-New Zealand origin. The age of participants ranged from 25 years to 42 years (mean 35.33, SD 5.219). On average, they had completed 11.4 years of education (SD 2.72), which is equivalent to having completed 5th Form or Year 11.

The average length of time in this episode of treatment (since most recent admission) for opiate dependence for the 15 participants was 5.4 years (range 3 months to 20 years, SD 5.8), with the daily dose of methadone averaging 87.98 mg (range 30 mg to 150 mg, SD 37.1). Of the sample, 6 individuals had received treatment for opioid dependence previously. Individuals reported that their first

substance use occurred between 12 and 29 years of age (mean 14.93, SD 4.32) with first opiate use occurring between 14 and 25 years (mean 18.36, SD 3.67).

Materials

The psychometric measures administered to each participant were identical to those administered in *Experiment 1* but included the Treatment Perceptions Questionnaire.

Treatment Perceptions Questionnaire (TPQ) (1998)

The Treatment Perceptions Questionnaire (Marsden, Bacchus, Stewart, Griffiths, Clarke, Gossop, & Strang, 1998) is a brief 10-item likert-type scale used to measure satisfaction with treatment for substance abuse problems. Of the 10 scale items, five questions assess the nature and extent of relationships with staff, and five items assess how the intervention is working, including the individual's perceptions of the rules and regulations. The greatest TPQ score possible is 40, with greater scores indicative of greater treatment satisfaction. Each item is scored on a scale of 0-4, (0 = strongly disagree to 4 = strongly agree). The TPQ was developed to assess client' satisfaction with treatment, and takes approximately 5 minutes to complete.

According to the authors (Marsden, Stewart, Gossop, Rolfe, Bacchus, Griffiths, Clarke, & Strang, 2000) the overall internal reliability for the TPQ is 0.76, and test-retest reliability for the items fell between 0.40 and 0.60, with the overall test-retest reliability being 0.57 indicating fair test-retest reliability. Discriminate validity results showed a difference in results for individuals in inpatient versus community treatment.

Adherence Measures

In addition, to the psychometric measures administered, the present study assessed treatment adherence. Previous research has used a number of methods to measure adherence, such as: missed medication; days on dose; reduced pick-up schedules; urinanalysis results; counsellor ratings; and programme tenure (Blaney & Craig, 1999). In the current research, limited information was available with regards to adherence, and retention in treatment at the Community Alcohol and Drug Service due to the limited information that was routinely collected. At the time of the research, the available options for the assessment of adherence were number of

missed doses of methadone, urinanalysis results, length of time on programme, number of takeaway doses of methadone prescribed, and attendance at doctor and keyworker appointments. Following discussion with staff at CADS, and a review of the MMT programme at CADS, the two adherence measures deemed to be the most suitable were the number of missed methadone doses, and attendance at doctors' appointments. Results of urinanalysis were not considered to be appropriate as the CADS MMT programme is run under a harm reduction philosophy, and a reduction in substance use is not required to remain on the programme. Length of time on the MMT programme was not included as this was considered to be a retention, and not an adherence measure. Attendance at keyworker appointments was also excluded, as attendance at keyworker appointments is not compulsory.

The selected adherence measures (number of missed methadone doses, and attendance at doctors' appointments) were assessed as follows:

- The number of missed doses of methadone was based on records kept by the service (present service criteria states that the prescription pharmacy must notify CADS if an individual fails to pick up their dose of methadone for the day). Individuals with takeaway doses (where more than one dose can be picked up for use on consecutive days) were considered to have consumed on all days if they picked up their takeaway doses and there were no reports of replacement doses made in the file notes. Similarly, individuals who failed to pick up their takeaway doses, without replacement doses prescribed, were considered to have missed doses on those days.
- The number of missed doctors' appointments was based on the two appointments scheduled most recently. An individual was considered to have missed/not attended a scheduled appointment if they failed to attend the initial scheduled appointment, or the replacement appointment if one was scheduled within two weeks of the original appointment. The percentage of appointments that were attended was based on the two initial appointments scheduled most recently (if individuals attended the replacement appointment they were considered to have met the criterion for attendance at the scheduled appointment). This approach has been used previously by Gutierrez, Ballesteros, Gonzalez-Oliveros, & Ruiz de Apodaka (1995) who had a

criterion of unjustified absence from 5 consecutive or 10 alternative follow-up appointments. For some participants, information on the number of doctor appointments attended was available for the previous two appointments only. Therefore, this was selected as the number of appointments for the adherence criterion.

Procedure

Prior to the commencement of this research, ethical approval was obtained from the Psychology Department Human Research Ethics Committee at the University of Waikato and the Northern Y Regional Ethics Committee (part of the Health and Disability Ethics Committee).

Participants were recruited from the Community Alcohol/Drug Service (CADS) in Hamilton, New Zealand between January 2005 and December 2005. All individuals were on the MMT programme run by this service. Participants were recruited through information fliers posted at CADS (see Appendix VII), and through information provided by staff to consumers of the service. Individuals were eligible to participate in the research if they had been enrolled in the methadone programme at CADS Hamilton for at least 3 months and were over the age of 18 years. Individuals were excluded from participation if they were deemed to be intoxicated by staff at the service (either alcohol or substance induced) at the time of the interview or if they had a current major mental illness (judged on a case by case basis).

All individuals on the MMT programme were given the opportunity to participate, and provided that they meet the established criteria they were invited to take part in the research. Exclusion criteria were kept to a minimum to allow for a truer representation of this population, with the aim of producing results that were meaningful for the entire population, and not just a select minority. The minimum requirement of three months on the MMT programme was required to ensure stabilisation on methadone, as previous research has suggested that individuals should not be tested within 2 to 4 weeks of admission to treatment as results during this time may be affected by residual intoxication effects (Woods, Freitas, & Fas-Stewart, 1999). Exclusion due to intoxication or substance impairment was assessed on the day of the interview, as research has suggested that impaired individuals may not comprehend fully what they are agreeing to participate in (McCrady & Bux Jr., 1999). The initial interview was also used to assess each participant’s eligibility to

participate, in relation to the other inclusion/exclusion criteria. No limitations were placed on how recently the participants had consumed their most recent dose of methadone; however, the recency of methadone dose was added as a covariate in the analysis of that data that was obtained.

Individuals who agreed to take part in the research, were provided with the information sheet about the research (see Appendix VIII), and once they had completed the necessary consent forms (see Appendix IX) they were administered the neuropsychological tests, and asked a short series of questions regarding recent substance/alcohol use, and previous head injuries (see Appendix X). The neuropsychological tests were administered in the same order as *Experiment 1*. The Treatment Perceptions Questionnaire was administered at the end of the test sequence. All interviews were conducted on a one on one basis in a room at the Community Alcohol & Drug Service and took approximately 1 ½ to 2 hours to complete. Individuals were provided with a refreshment break during the assessment. Following the completion of the assessment, individual participation was recorded in the individuals file at CADS (see Appendix XI).

Individuals were required to consent to a review of their file in order to assess their adherence to MMT, and to gain further demographic information (i.e. current diagnoses, or information unable to be obtained during the assessment). Results of the participant's most recent urinanalysis (this was already a requirement for inclusion on the MMT programme) were reviewed in order to determine the possible influence of other substances on the validity of the test results. While exclusion criteria minimised the chance that individuals were intoxicated at the time of testing, residual effects of recent substance use may have affected results. As this was difficult to guard against, the aim was to include positive urine analysis results as a covariate when analysing the data.

Participants were provided with refreshments and tea/coffee when they participated in the research, as it was considered to be inappropriate to give them a financial incentive. Previous research in this area has suggested that financial incentives could be considered as coercion to participate (Cunningham, 1998; Galanter & Kleber, 1999; McCrady & Bux Jr., 1999).

Demographic Information

Demographic information was collected through the short demographic questionnaire completed by participants, and through file reviews (e.g., previous drug use, DSM diagnoses). This information is collected for all individuals on initial assessment for admission to the MMT programme. The length of time an individual had been using opiates was excluded from analysis as many participants could not give specific details in this area and insufficient information could be obtained from files regarding years of use, previous admissions, and 'clean years'.

Scoring and data entry

Scoring and data entry were conducted as outlined in *Experiment 1*. Participants in the current study were given the option of receiving feedback on the results of the testing, and if participants agreed, this information was provided for inclusion in their case notes at CADS. The feedback consisted of general information regarding their overall functioning on each measure (e.g., the results of the memory test suggest that you are unlikely to have difficulty remembering information that you hear and information that you see) and also general skills for improvement of functioning (e.g., you may find that having information repeated is helpful, and writing down information, keeping a diary, or leaving post-it notes on the fridge might also be useful). In cases where there were significant concerns regarding the impairments found on the conducted measures, these were discussed with staff at CADS. In cases where there were concerns regarding harm to self or others (i.e. suicidal ideation question on BDI-II) these were further discussed with the participant to further ascertain risk issues, and where applicable risk issues were discussed with staff at CADS. If consultation with staff had not been available, and where there were ongoing concerns regarding risk, the researcher had the necessary Crisis Assessment and Treatment Team (CATT) contact details for the Hamilton region so that further advice could be accessed.

Analysis was conducted using SPSS Version 12, and was based on the same psychometric scores outlined in *Experiment 1*. Analysis of the Treatment Perception Questionnaire was based on the total score obtained from this scale, responses to individual questions, and on the two factors identified in the development of the TPQ – staff perceptions and program perceptions (Marsden et al., 2000). In the case of missing data, if only one answer was missing from a scale or subscale, an average

value was calculated by the researcher. Otherwise, data was coded as missing, and was not included in that section of the analysis.

RESULTS

This study was conducted to assess the occurrence of cognitive impairments in individuals receiving MMT in New Zealand. A sample of 15 individuals in MMT were recruited from the CADS in Hamilton, New Zealand.

As shown in Table 3.1, the sample had a mean age of 35.33 years, and were predominantly of New Zealand European descent. There were a similar number of male and female participants, and on average they had completed the equivalent of 5th Form or Year 11/NCEA Level 1.

Table 3.1

Demographic details of Methadone Sample

Age	35.33	SD 5.219, Range 25-42
Gender		
Male	8	53.30%
Female	7	46.70%
Education	11.4	SD 2.72, Range 9-17
Handedness		
Left	3	20%
Right	12	80%
Ethnicity		
NZ European/Pakeha	12	80%
Maori	1	6.7%
Other European	2	13.3%
Methadone Maintenance		
Time in Methadone Program	5.44 years	SD 5.802, Range 3 months-20 years
Present dose of Methadone	87.98mg	SD 37.10, Range 30-150
Previous Treatment Episodes	1.07	SD 1.58, Range 0-4
Substance History		
First Drug Use	14.93	SD 4.323, Range 12-29
First Opiate Use	18.36	SD 3.67, Range 14-25

As previously mentioned, the participants had been in the current episode of treatment for opiate dependence 5.44 years on average, and were prescribed a

methadone dose of 87.98 mg daily on average. Six participants had received treatment for opioid dependence previously, with the mean number of treatment episodes being 1.07. Participants reported that their first substance use occurred between 12 and 29 years with first opiate use occurring between 14 and 25 years.

Performance on the psychometric tests

Prior to any analysis, Shapiro-Wilks tests were conducted to assess the distribution of the data for normality. Results from this analysis suggested that data for the TMT Part B Percentile Score ($W = 0.706$, $df = 15$, $p < 0.05$) were not normally distributed. Subsequently, transformations were conducted on these data, however, these failed to normalise the distribution of the data. As there are no non-parametric equivalents to the one sample t-test, the standard one sample t-test was used.

A series of one sample t-tests was conducted to compare the results obtained with the normative data provided in the administration manuals for each test, with the exceptions of the BAI and BDI-II. The BAI data were compared to the non-student sample described in the BAI Manual (Beck & Steer, 1990), and the BDI-II data were compared to the university student sample described in the BDI-II Manual (Beck, Steer, & Brown, 1996), as other non-clinical data are not provided.

The one sample t-tests showed significant differences between the obtained and normative data for a number of measures. A summary of these results is shown in Table 3.2. The Methadone sample obtained significantly lower scores than the normative sample for the Family Pictures I and II subtests, for all index score measures of the WMS-II-A, WIAT-II-A Numerical subtest and Composite Score, Trail Making Part B Percentile Score, and for all measures of the WCST-A with the exception of nonperseverative errors. However, they scored significantly higher than the normative data for the WIAT-II-A Word Reading subtest, Stroop Interference measure, and all NART-II measures. Significantly higher scores were also found for the BAI, which is indicative of increased anxiety symptomology. Medium effect sizes were obtained for the WMS-III-A Immediate Memory and Delayed Memory, all measures of the NART-II, and all measures of the WCST-A with the exception of Nonperseverative Errors. Large effect sizes were obtained when using Cohen's *d* for the WMS-III-A Family Pictures I and II subtests and Total Memory, the WIAT-II-A Numerical Operations subtest, and the BAI. Results from all other measures were not statistically different from the normative sample.

A comparison of the obtained results to the normative standard deviation ranges provided for each measure showed that, while the sample differed significantly from the normative data on a number of measures, the mean scores fell within one standard deviation for all measures, with the exception of the WIAT-II-A Numerical operations subtest and the BAI. The mean score on the BAI for the Methadone sample fell in the moderate range, with the majority of participants (33.33%) obtaining scores in the severe range, followed by the moderate and mild (both 26.67%), and minimal (13.33%) ranges. The mean score for the Methadone sample on the Beck Depression Inventory-II fell within the mild range, with the majority of participants obtaining a result in the minimal range (40%) followed by the mild (26.67%), severe (20%) and moderate (13.33%) ranges. A summary of the mean and standard deviations for each measure is provided in Table 3.3.

As the mean scores obtained by the sample may not reflect the score of any one individual, the sample data were analysed for each participant to assess overall impairment at one and two standard deviations below the normative mean for each measure. The number of individuals who obtained scores either one or two standard deviations below the normative mean is given in Table 3.4. Only one standard deviation (16^{th} Percentile) is given for the Trail Making test as normative data are not provided for two standard deviations. It should be noted that while 13 participants attempted the Wisconsin Card Sorting Test, only 12 participants completed the task. This suggests that the score of the one individual who failed to complete the task might have fallen more than one or two standard deviations below the normative mean had they finished the task. On closer examination it was found that one participant obtained a score two standard deviations below the normative mean on all measures of the WMS-III-A. Obtained scores more than two standard deviations below the normative mean on all other measures, were not the data from a single participant.

Relation between demographic and psychometric test results

As in *Experiment 1*, possible relations between psychometric test results and anxiety, depression, age, years of education, handedness and gender were assessed. Table 3.5 shows that the BAI negatively correlated with the Stroop Colour T-Score and Stroop Colour-Word T-Score (greater anxiety symptoms associated with poorer Stroop performance). The Beck Depression Inventory-II positively correlated with the

Logical Memory I and II subtests of the WMS-III-A (greater depression symptoms associated with better WMS-III-A scores), and correlated negatively with the Stroop Colour-Word T-Score (greater depression symptoms associated with worse Stroop scores).

The relation between age and obtained score was assessed for the NART-II, as this did not provide age adjusted normative data. Table 3.5 shows that age did not significantly correlate with scores obtained on the NART-II. Years of education was positively correlated with the Trail Making B (higher scores on TMT associated with more years of education), but did not correlate with any other measure.

Gender did not correlate with any of the measures, while handedness correlated with the Trail Making Test Part B Percentile Score (left handedness associated with a better result). This result should be interpreted with caution as the distribution differed significantly from normal, and only 3 participants were left handed.

As well as these moderating factors, the literature has suggested that methadone itself may affect cognitive ability (e.g., Rapeli, Fabritius, Alho, Salaspuro, Wahlbeck, & Kalska, 2007). Thus, a series of correlations was conducted to assess the relation between psychometric test results and dose of methadone, length of time on MMT (years), and time since last methadone dose. As shown in Table 3.6, methadone dose did not correlate significantly with any of the psychometric measures, and time on MMT was negatively correlated with Nonperseverative Errors on the WCST-A (increased time in MMT associated with poorer scores on Nonperseverative Errors).

Length of time since last dose was positively correlated with the WMS-III-A Family Pictures I and Family Pictures II scores; however, this correlation was due to one outlier who had not consumed a dose of methadone in the previous 24 hours. When this participant was excluded from analysis the correlation was not significant ($r = 0.319$, $p < 0.05$ and $r = 0.277$, $p < 0.05$ respectively).

As discussed in the *Method* section, participants were not excluded if they had experienced a head injury or overdose previously. Pearson Correlations were conducted to assess the relation between the number of head injuries reported and the number of previous overdoses in relation to the psychometric tests. Number of head injuries was negatively correlated with all measures from the NART-II. Number of overdoses was positively correlated with the TMT Part B Percentile score and Beck Anxiety Inventory score. However, the significant correlations obtained for number of

head injuries and number of overdoses should be interpreted with caution as these were based on self-report and these data may be inaccurate.

Other Drug Use

Of the 15 individuals in this sample, 11 individuals reported using other substances within the prior 48 hours. Of these, 5 reported cannabis use, 4 reported benzodiazepine use, one reported alcohol and cannabis use, and one participant reported using benzodiazepines, morphine, cannabis and alcohol in the previous 48 hours.

In order to determine the influence of other drug use on psychometric tests results, the sample was split into five groups based on what other drugs the individuals identified as using. Group membership was as follows: no other drug use; benzodiazepine use; alcohol and cannabis use; and benzodiazepine, morphine, cannabis and alcohol use.

The obtained scores on each of the psychometric tests were assessed using Kruskal-Wallis tests across the five groups within the Methadone sample. The results of these tests are outlined in Table 3.7, and show that performance on the psychometric tests was not influenced by the other substances use that was reported.

Satisfaction with Treatment

The Treatment Perceptions Questionnaire (TPQ) was used to assess satisfaction with treatment. Scores on the TPQ were variable (mean 23.15, SD 5.82, range 14 – 33), however, general themes regarding the methadone programme were evident from the personal opinion section that was included in the questionnaire. Individuals felt that MMT as a treatment option resulted in a loss of freedom (e.g., requirement to consume dose under supervision on a regular basis); they were condemned for attempts to reduce illicit use; they were ‘treated like children’; and the consequences of not complying with the treatment programme were inconsistent.

The data from the TPQ were analysed further to assess for trends in treatment satisfaction. The TPQ was analysed in regards to both individual questions, and to the two factors identified in the development of the TPQ – staff perceptions and program perceptions (Marsden et al., 2000). An analysis of the individual questions indicated lower mean scores (lower satisfaction) on three questions: ‘The staff have not always understood the kind of help I wanted’ (1.62, SD 1.45), ‘The staff and I have had

different ideas about what my treatment objectives should be' (1.69, SD 0.85) and 'I have not liked some of the treatment rules or regulations' (1.23, SD 1.16). Higher scores (greater satisfaction) were noted on two questions: 'I think the staff have been good at their jobs' (3.23, SD 0.60) and 'I have received the help that I was looking for' (3.00, SD 1.08). Analysis using the two factors identified by Marsden et al. (2000) found similar mean scores on both the Staff Perceptions factor (11.62, SD 3.48) and the Program Perceptions factor (11.54, SD 3.02).

Pearson Correlations were conducted to assess the relation between TPQ scores and length of time in the MMT programme and methadone dose. No significant correlations were found between length of time in the MMT programme and TPQ Total Score (r = -0.056), Staff Perceptions (r = -0.207), or Program Perceptions (r = 0.132) factors. Similarly, no significant correlations were found between methadone dose and TPQ Total Score (r = 0.001), Staff Perceptions (r = 0.003) or Program Perceptions (r = -0.001) factors.

Neuropsychological Performance & Treatment Adherence

Adherence to treatment in the current sample was measured by attendance at scheduled doctors' appointments and number of missed doses of methadone. As mentioned in the *Method* section, individuals were deemed to have adhered to the treatment programme if they had not missed a dose of methadone, and had attended their last two appointments (or replacement appointments if scheduled within two weeks). Nine of the 15 individuals in the Methadone sample had attended their two most recent appointments, while the remaining 6 had attended one of the last two most recent appointments. None of the participants had missed consumption of their dose of methadone within the last month.

To determine if there were differences between those who adhered to treatment requirements and those that had not, a series of independent sample t-tests and Mann-Whitney U tests were conducted. Both an independent samples t-test and a Mann Whitney U test were conducted for each psychometric measure, as data for both groups on several of the measures were not normally distributed. In all cases, both tests showed the same result. Therefore, the independent sample t-test results only, are reported here. These results are outlined in Table 3.8, and show no statistically significant differences for any of the psychometric measure, although significant differences were found for the TPQ Total score and TPQ Program Perceptions factor

score. The individuals who attended only one of their last two appointments obtained lower scores (lower satisfaction) than the other individuals on both of these measures.

Medium effect sizes were obtained for the WMS-III-Logical Memory II subtest, WIAT-II-A Word Reading and Numerical Operations subtests, BDI-II, NART Verbal IQ score, WCST-A Conceptual Level Responses and TPQ Staff Perceptions score. Large effect sizes were obtained for the WIAT-II-A Composite score, TMT Part A Percentile Score, WCST-A Total Number of Errors, and the TPQ Total and Program Perceptions scores.

TABLE 3.2

One sample t-test comparing Methadone Sample to Normative Data, including means, standard deviations and Cohen's d

	Normative		Methadone		t	df	Significance	Cohens *d*
	Mean	SD	Mean	SD				
WMS Logical Memory I	10	3	9.00	3.23	-1.20	14	NS	-0.33
WMS Family Pictures I	10	3	7.40	2.50	-4.03	14	*	-0.87
WMS Logical Memory II	10	3	8.80	3.34	-1.39	14	NS	-0.40
WMS Family Pictures II	10	3	7.27	3.13	-3.38	14	*	-0.91
WMS Immediate Memory	100	15	89.53	14.03	-2.89	14	*	-0.70
WMS Delayed Memory	100	15	89.73	14.81	-2.68	14	*	-0.68
WMS Total Memory	100	15	88.73	14.14	-3.09	14	*	-0.75
WIAT Word Reading	100	15	105.69	5.48	3.74	12	*	0.38
WIAT Numerical Operations	100	15	82.54	16.51	-3.81	12	*	-1.16
WIAT Spelling	100	15	98.54	9.47	-0.56	12	NS	-0.10
WIAT Composite	100	15	93.00	8.38	-3.01	12	*	-0.47
TMT Part A Percentile	50	16	49 th	26.15	-0.20	14	NS	-0.04
TMT Part B Percentile	50	16	22nd	18.19	-6.03	14	*	-0.83
Stroop Word T-Score	50	10	46.21	11.27	-1.26	13	NS	-0.38
Stroop Colour T-Score	50	10	45.57	8.16	-2.03	13	NS	-0.44
Stroop Colour-Word T-Score	50	10	54.93	9.59	1.92	13	NS	0.49
Stroop Interference T-Score	50	10	54.86	6.74	2.70	13	*	0.49
NART Full Scale IQ	100	15	111.00	5.32	8.01	14	*	0.73
NART Verbal IQ	100	15	111.87	6.91	6.65	14	*	0.79
NART Performance IQ	100	15	111.40	7.74	5.71	14	*	0.76
Beck Anxiety Inventory	7.78	5.65	19.20	10.81	4.09	14	*	2.02
Beck Depression Inventory	12.56	9.93	17.40	11.06	1.70	14	NS	0.49
WCST Total Number of Errors	100	15	90.92	7.025	-4.48	11	*	-0.61
WCST Perseverative Responses	100	15	91.33	8.63	-3.48	11	*	-0.58
WCST Persevertive Errors	100	15	90.00	9.47	-3.66	11	*	-0.67
WCST Nonperseverative Errors	100	15	92.83	11.99	-2.07	11	NS	-0.48
WCST Conceptual Level Response	100	15	89.67	7.69	-4.65	11	*	-0.69

* Significant at $p < 0.05$

TABLE 3.3

Means and Standard Deviations for Normative and Methadone Sample

	Normative Mean	One Standard Deviation	Methadone Mean	Methadone SD
WMS Logical Memory I	10	3	9.00	3.23
WMS Family Pictures I	10	3	7.40	2.50
WMS Logical Memory II	10	3	8.80	3.34
WMS Family Pictures II	10	3	7.27	3.13
WMS Immediate Memory	100	15	89.53	14.03
WMS Delayed Memory	100	15	89.73	14.81
WMS Total Memory	100	15	88.73	14.14
WIAT Word Reading	100	15	105.69	5.48
WIAT Numerical Operations	100	15	82.54	16.51
WIAT Spelling	100	15	98.54	9.47
WIAT Composite	100	15	93.00	8.38
TMT Part A Percentile	50th	16th	49 th	26.15
TMT Part B Percentile	50th	16th	22nd	18.19
Stroop Word T-Score	50	10	46.21	11.27
Stroop Colour T-Score	50	10	45.57	8.16
Stroop Colour-Word T-Score	50	10	54.93	9.59
Stroop Interference T-Score	50	10	54.86	6.74
NART Full Scale IQ	100	15	111.00	5.32
NART Verbal IQ	100	15	111.87	6.91
NART Performance IQ	100	15	111.40	7.74
Beck Anxiety Inventory	7.78	5.65	19.20	10.81
Beck Depression Inventory	12.56	9.93	17.40	11.06
WCST Total Number of Errors	100	15	90.92	7.025
WCST Perseverative Responses	100	15	91.33	8.63
WCST Persevertive Errors	100	15	90.00	9.47
WCST Nonperseverative Errors	100	15	92.83	11.99
WCST Conceptual Level Response	100	15	89.67	7.69

Table 3.4

Number of individuals obtaining scores One and Two Standard Deviations below norm

	n	1 SD	2 SD
WMS Logical Memory I	15	5	1 [h]
WMS Family Pictures I	15	7	1 [h]
WMS Logical Memory II	15	5	1 [h]
WMS Family Pictures II	15	6	2 [b,h]
WMS Immediate Memory	15	4	1 [h]
WMS Delayed Memory	15	4	1 [h]
WMS Total Memory	15	5	1 [h]
WIAT Word Reading	13	0	0
WIAT Numerical Operations	13	7	2 [i,k]
WIAT Spelling	13	1	0
WIAT Composite	13	2	0
TMT Part A Percentile	15	2	
TMT Part B Percentile	15	9	
Stroop Word T-Score	14	0	2 [a,k]
Stroop Colour T-Score	14	2	1 [a]
Stroop Colour-Word T-Score	14	0	0
Stroop Interference T-Score	14	0	0
NART Full Scale IQ	15	0	0
NART Verbal IQ	15	0	0
NART Performance IQ	15	0	0
WCST Total Number of Errors	12	2	0
WCST Perseverative Responses	12	2	0
WCST Persevertive Errors	12	2	1 [k]
WCST Nonperseverative Errors	12	4	0
WCST Conceptual Level Response	12	5	0

a, b, h, i, k = Participants 1, 2, 8, 9 and 11 respectively

Table 3.5

Correlations between demographic and psychometric test results for the Methadone Sample

	Correlation Coeffient (r)					
	Pearsons	Point Biserial	Point Biserial	Pearsons	Pearsons	Pearsons
	Age	Gender	Handedness	Years of Education	Beck Anxiety	Beck Depression
WMS Logical Memory I		0.428		0.114	0.285	**0.534***
WMS Family Pictures I		0.288		0.006	0.147	-0.109
WMS Logical Memory II		0.472		0.222	0.395	**0.536***
WMS Family Pictures II		0.315		0.045	-0.029	-0.092
WMS Immediate Memory		0.446		0.082	0.228	0.240
WMS Delayed Memory		0.419		0.107	0.224	0.238
WMS Total Memory		0.429		0.092	0.250	0.237
WIAT Word Reading		0.122			0.180	0.027
WIAT Numerical Operations		0.294			0.219	-0.077
WIAT Spelling		0.513			0.012	0.402
WIAT Composite		0.383			0.145	0.095
TMT Part A Percentile		-0.294	0.191	0.028	-0.055	0.332
TMT Part B Percentile		0.177	**0.759***	**0.541***	0.105	0.245
Stroop Word T-Score		-0.243			-0.326	-0.105
Stroop Colour T-Score		0.400			**-0.676***	-0.329
Stroop Colour-Word T-Score		0.131			**-0.560***	**-0.587***
Stroop Interference T-Score		0.198			-0.148	-0.428
NART Full Scale IQ	-0.069	0.338			-0.224	0.187
NART Verbal IQ	-0.088	0.339			-0.204	0.192
NART Performance IQ	-0.078	0.325			-0.212	0.195
Beck Anxiety Inventory		0.059				0.389
Beck Depression Inventory		0.328			0.389	
WCST Total Number of Errors		0.366			0.067	-0.302
WCST Perseverative Responses		0.157			0.485	-0.065
WCST Persevertive Errors		-0.131			0.182	-0.369
WCST Nonperseverative Errors		0.267			-0.310	-0.130
WCST Conceptual Level Response		0.306			-0.215	-0.377

* Significant at $p < 0.05$

Table 3.6

Correlations between methadone and psychometric results for the Methadone Sample

	Correlation Coeffient (r)				
	Pearsons	Pearsons	Pearsons	Point Biserial	Point Biserial
	Time in Treatment	Methadone Dose	Time Since Dose	Head Injury	Overdose
WMS Logical Memory I	0.1	0.415	0.222	-0.262	0.506
WMS Family Pictures I	0.47	-0.076	**0.663***	-0.046	0.087
WMS Logical Memory II	0.062	0.098	0.152	-0.088	0.318
WMS Family Pictures II	0.451	0.097	**0.663***	-0.251	-0.127
WMS Immediate Memory	0.312	0.236	0.499	-0.205	0.298
WMS Delayed Memory	0.307	0.076	0.486	-0.181	0.075
WMS Total Memory	0.32	0.150	0.507	-0.198	0.199
WIAT Word Reading	0.101	-0.541	0.227	-0.512	-0.066
WIAT Numerical Operations	0.094	-0.477	-0.133	-0.333	0.284
WIAT Spelling	0.119	-0.140	0.019	-0.550	-0.255
WIAT Composite	0.122	-0.463	-0.038	-0.532	-0.006
TMT Part A Percentile	0.291	-0.096	-0.165	-0.166	-0.122
TMT Part B Percentile	0.281	-0.101	-0.147	-0.334	**0.607***
Stroop Word T-Score	-0.065	-0.427	-0.008	-0.349	-0.273
Stroop Colour T-Score	0.067	-0.489	0.433	-0.476	-0.473
Stroop Colour-Word T-Score	-0.104	-0.256	0.495	-0.191	-0.482
Stroop Interference T-Score	-0.187	-0.042	0.476	0.093	-0.189
NART Full Scale IQ	0.445	-0.033	0.215	**-0.621***	-0.317
NART Verbal IQ	0.446	0.037	0.208	**-0.643***	-0.282
NART Performance IQ	0.453	0.016	0.196	**-0.624***	-0.292
Beck Anxiety Inventory	-0.175	0.007	-0.077	0.048	**0.751***
Beck Depression Inventory	-0.208	0.238	-0.316	-0.217	0.402
WCST Total Number of Errors	-0.37	-0.029	0.233	0.174	0.066
WCST Perseverative Responses	-0.044	0.045	0.204	0.453	0.490
WCST Persevertive Errors	0.162	0.000	0.343	0.438	0.228
WCST Nonperseverative Errors	**-0.719***	0.117	-0.186	-0.139	0.015
WCST Conceptual Level Response	-0.363	-0.027	0.458	0.084	-0.197

* Significant at $p < 0.05$

Table 3.7

Kruskal Wallis Test for effects of other substance use for the Methadone Sample

	No Other Use			Cannabis Use			Alcohol & Cannabis Use		Benzodiazepine Use		
	n	Mean	SD	n	Mean	SD	n	Mean	n	Mean	SD
WMS Logical Memory I	4	10.25	3.95	5	8.20	1.64	1	12.00	4	8.00	4.69
WMS Family Pictures I	4	9.25	3.30	5	6.60	1.82	1	9.00	4	6.75	2.22
WMS Logical Memory II	4	9.25	2.06	5	7.80	2.17	1	14.00	4	8.75	5.44
WMS Family Pictures II	4	9.50	3.42	5	6.80	2.59	1	8.00	4	5.50	3.70
WMS Immediate Memory	4	98.50	15.02	5	85.40	6.54	1	102.00	4	84.25	19.92
WMS Delayed Memory	4	97.50	12.82	5	84.40	10.01	1	106.00	4	85.75	21.93
WMS Total Memory	4	96.75	13.89	5	83.80	7.98	1	104.00	4	84.50	20.40
WIAT Word Reading	4	104.50	5.74	5	106.60	6.66	1	109.00	2	101.50	0.71
WIAT Numerical Operations	4	72.50	10.50	5	83.80	21.48	1	108.00	2	84.00	1.41
WIAT Spelling	4	99.00	6.73	5	98.00	10.54	1	99.00	2	92.50	16.26
WIAT Composite	4	89.50	7.19	5	93.60	10.64	1	100.00	2	90.50	6.36
TMT Part A Percentile	4	57.50	18.93	5	42.00	28.42	1	80.00	4	32.50	23.98
TMT Part B Percentile	4	16.25	9.46	5	21.00	15.17	1	75.00	4	12.50	5.00
Stroop Word T-Score	4	43.75	1.71	5	48.80	17.17	1	50.00	3	42.67	13.05
Stroop Colour T-Score	4	47.00	6.98	5	50.00	7.71	1	45.00	3	37.33	9.07
Stroop Colour-Word T-Score	4	57.00	8.49	5	57.60	12.24	1	46.00	3	52.33	10.07
Stroop Interference T-Score	4	56.50	7.33	5	54.20	8.23	1	49.00	3	56.33	7.09
NART Full Scale IQ	4	113.25	7.54	5	113.40	4.62	1	112.00	4	106.25	7.80
NART Verbal IQ	4	113.00	8.04	5	113.00	5.43	1	112.00	4	105.00	8.68
NART Performance IQ	4	112.25	5.56	5	112.20	3.83	1	111.00	4	106.50	5.80
WCST Total Number of Errors	3	86.67	10.69	5	91.60	6.88	1	92.00	2	95.50	4.95
WCST Perseverative Responses	3	91.67	2.89	5	89.80	7.22	1	101.00	2	98.50	9.19
WCST Persevertive Errors	3	90.33	5.86	5	86.00	11.53	1	98.00	2	97.50	10.61
WCST Nonperseverative Errors	3	84.67	7.51	5	102.60	11.67	1	80.00	2	91.50	0.71
WCST Conceptual Level Response	3	88.67	12.06	5	90.60	8.35	1	85.00	2	93.50	0.71

* Signficant at $p < 0.05$

Table 3.8

Independent Samples t-test comparing attendence at doctors appointments in Methadone Sample, including means, standard deviations and Cohen's d

	One appointment		Two appointments					Cohens
	Mean	SD	Mean	SD	t	df	Significance	*d*
WMS Logical Memory 1	9.83	1.72	8.44	3.94	0.81	13	NS	0.42
WMS Family Pictures 1	7.67	3.08	7.22	2.22	0.33	13	NS	0.17
WMS Logical Memory 2	9.67	2.80	8.22	3.70	0.81	13	NS	0.50
WMS Family Pictures 2	7.67	3.72	7.00	2.87	0.39	13	NS	0.21
WMS Immediate Memory	93.00	13.13	87.22	14.89	0.77	13	NS	0.41
WMS Delayed Memory	93.33	15.47	87.33	14.76	0.76	13	NS	0.40
WMS Total Memory	92.17	14.36	86.44	14.36	0.76	13	NS	0.40
WIAT Word Reading	107.40	5.41	104.63	5.60	0.88	11	NS	0.50
WIAT Numerical Operations	90.00	16.91	77.88	15.47	1.33	11	NS	0.76
WIAT Spelling	101.20	11.97	96.88	7.97	0.79	11	NS	0.45
WIAT Composite	97.40	9.50	90.25	6.80	1.59	11	NS	0.91
TMT Part A Percentile	36.67	28.93	56.67	22.22	-1.52	13	NS	-0.80
TMT Part B Percentile	19.17	11.14	23.33	22.22	-0.42	13	NS	-0.22
Stroop Word T-Score	46.50	10.13	46.00	12.75	0.08	12	NS	0.04
Stroop Colour T-Score	45.00	11.47	46.00	5.40	-0.22	12	NS	-0.12
Stroop Colour-Word T-Score	56.67	10.09	53.63	9.66	0.57	12	NS	0.31
Stroop Interference T-Score	58.00	6.36	52.50	6.37	1.60	12	NS	0.86
Beck Anxiety Inventory	21.17	10.55	17.89	11.40	0.56	13	NS	0.30
Beck Depression Inventory	13.33	6.25	20.11	12.99	-1.18	13	NS	-0.62
NART Full Scale IQ	112.50	5.24	110.00	5.43	0.88	13	NS	0.47
NART Verbal IQ	114.00	6.45	110.44	7.20	0.98	13	NS	0.51
NART Performance IQ	113.67	7.45	109.89	7.98	0.92	13	NS	0.49
WCST Total Number of Errors	94.40	3.51	88.43	8.06	1.54	10	NS	0.90
WCST Perseverative Responses	89.20	12.32	92.86	5.37	-0.62	10	NS	-0.41
WCST Persevertive Errors	91.80	9.42	88.71	10.03	0.54	10	NS	0.32
WCST Nonperseverative Errors	94.40	12.46	91.71	12.51	0.37	10	NS	0.21
WCST Conceptual Level Response	93.00	5.34	87.29	8.58	1.31	10	NS	0.77
TPQ Total Score	19.20	5.07	25.63	5.01	-2.24	11	*	-1.28
TPQ Staff Perceptions	10.20	3.96	12.50	3.07	-1.18	11	NS	-0.67
TPQ Program Perceptions	9.00	1.73	13.13	2.53	-3.18	11	*	-1.81

* Significant at p< 0.05

DISCUSSION

In this study, the cognitive functioning of 15 individuals in an MMT programme was assessed. This sample obtained lower scores than the normative sample for the Family Pictures I and II subtests and index scores of the WMS-III-A, the WIAT-II-A Numerical Operations subtest and Composite score, TMT Part B Percentile Score, and all measures of the WCST-A with the exceptions of Nonperseverative Errors. The Methadone sample obtained higher scores than the normative sample for the WIAT-II-A Word Reading subtest, Stroop Interference T-Score, and all NART-II measures. This sample also obtained a higher score than the normative sample on the BAI which is indicative of increased anxiety symptomology (Beck & Steer, 1990). The obtained scores for the sample, while statistically different from the normative data, fell within one standard deviation of the test norms on all measures, with the exception of the WIAT-II-A Numerical operations subtest and the BAI.

Obtained psychometric results were not shown to differ between individuals that attended both of their two most recently scheduled appointments and those who had attended one of their two most recently scheduled appointments, however, those who attended only one of the appointments obtained lower scores on the TPQ Total and TPQ Program Perceptions factor score, which indicates lower treatment satisfaction.

These findings are discussed below.

Wechsler Memory Scale-III-Abbreviated

While studies have used subtests from the WMS to assess memory functioning in methadone populations, no studies appear to have used the Logical Memory and Family Pictures subtests which comprise the WMS-III-A. Research using other memory measures does suggest that impairments are likely to be reported in working memory, and long-term visual and verbal memory (Darke, Sims, McDonald, & Wickes, 2000; Mintzer & Stitzer, 2002; Verdejo, Toribio, Orozco, Puente, & Perez-Garcia, 2005), however, the results regarding impairments in short-term visual and verbal memory have been reported less consistently (Curran, Kleckham, Bearn, Strang, & Wanigaratne, 2001; Darke, Sims, McDonald, & Wickes, 2000; Gritz,

Shiffman, Jarvik, Haber, Dymond, Coger, Charuvastra, & Schlesinger, 1975; Kelley, Welch, & McKnelley, 1978).

The current sample obtained poorer results compared to the normative sample on the measures of both short and long-term visual, and on overall measures of immediate, delayed and total memory ability. Effect sizes for all of these measures were either medium or large suggesting that while the sample was small, the statistically significant results are robust. The obtained results were, however, within one standard deviation of the normative mean. The results for the current sample, with regards to poorer results in visual memory, concur with research in this area, although this sample was not considered to be clinical impaired as mean results were within one standard deviation of the normative mean. These results contrast with previous research in this area. The findings for this sample may have differed from those reported by previous researchers due to differences in the measures used, as while measures often purport to measure the same are of cognitive functioning, disparity in results suggests that these measures that may be measuring slightly different aspects of the same cognitive ability. The WMS-III-A, as used in this research, has been shown previously to mean the same memory construct as other well validated measures although recent research suggests that the Family pictures subtest of the WMS-III-A is more likely to be a measure of general or working memory (Chapin, Busch, Naugle, & Najm, 2008; Dulay, Schefft, Testa, Fargo, Privitera, & Yeh, 2002; Lezak, Howieson, Loring, Hannay, & Fisher, 2004; Lichtenberger, Kaufman, & Lai, 2001).

In addition to comparing the results to the normative means, methadone dose, time since last dose, and time on methadone were assessed in relation to the results. While methadone dose or time on methadone was not found to correlate with performance on the WMS-III-A, there was a relation between time since dose and scores, with higher scores associated with increased time since dose consumption. While this significant finding was associated with one outlier who had not consumed in the previous 24 hours, this finding does possibility suggest that methadone may cause short-term, temporary impairments in memory which may improve when methadone consumption is ceased.

The obtained differences may also be a result of the different opiates available in New Zealand. This may suggest that impairments seen in overseas opiate populations are not applicable in a New Zealand setting. As discussed previously,

results on tests of cognitive functioning have differed depending on the opiate used. As New Zealand has lower rates of heroin use than seen in many overseas countries (Field & Casswell, 1999), it is likely that there would be differences in the impairments of cognitive functioning of opiate users in New Zealand.

Overall, the current sample had more difficulty compared to the normative sample recalling information in a visual format, both short-term and after a delay. The findings on the visual memory subtest suggest that this sample is unlikely to have difficulty recalling information that they have heard. While the mean results for the verbal memory subtests were within the normative range, one third of participants in the sample obtained results either one or two standard deviations below the mean. This third of the sample are likely to have difficulty recalling information in verbal and visual formats, both immediately and after a delay and these difficulties are likely to have a clinically significant effect on their everyday lives, and in treatment sessions. Situations requiring visual recall in particular are likely to be more difficult for this population. The obtained results should also be compared to those obtained on the NART for the sample, which would suggest that while the sample obtained results in the normal range, these are significantly lower than would be expected. This may mean that individuals are more likely to report subjective memory impairments, although memory functioning ability still falls within the normative range.

Wisconsin Card Sorting Test-Abbreviated

The Methadone sample performed more poorly on all measures of the WCST-A with the exception of Nonperseverative Errors when compared to the normative data. Medium effect sizes were obtained on the same measures. The medium effect sizes suggest that while the sample was small, the statistically significant results are robust. However, while the results for the sample were statistically significant, the mean scores on the WCST-A all fell within one standard deviation of the normative mean. Similarly, individual results showed that the majority of the sample obtained results less than one standard deviation below the normative mean. These results suggest that while the sample obtained statistically significant results these were not clinically significant as these results did not fall more than one standard deviation below the normative mean (Kongs, Thompson, Iverson, & Heaton, 2000).

While results were not clinically significant for the majority of participants, there were some participants who obtained results more than one standard deviation

below the normative means on the WCST-A. On the Nonperseverative Errors measure, 4 individuals obtained results that were more than one standard deviation below the normative mean, and on the Conceptual Level Responses measure 5 individuals obtained a result more than one standard deviation below the normative mean. Those individuals, who obtained poorer scores on the Nonperseverative Errors measure, also obtained poorer results on the Conceptual Level Responses measure. This suggests that some individuals in the sample did have difficulties with problem solving, and specifically these individuals made more errors when solving a problem.

The majority of previous research studies using the WCST have reported impairments in the problem solving ability of methadone samples (Darke, Sims, McDonald, & Wickes, 2000; Verdejo, Toribio, Orozco, Puente, & Perez-Garcia, 2005), however, no studies appear to have used the WCST-A. As achievement on the WCST-A is thought to closely match that achieved on the WCST, comparisons between the two measures has been made in this research.

The poorer performance of the current sample is similar to that reported by Verdejo et al. (2005) and Darke et al. (2000), however, the mean results in the current study were not clinically significant (more than one standard deviation below the normative mean). On the WCST-A one standard deviation is the recommended threshold for classification of impairment as it is normal for individuals to obtain a score that would be considered impaired otherwise (Kongs, Thompson, Iverson, & Heaton, 2000). The difference in findings for the current sample when compared to the literature may be due to slight differences between the WCST and WCST-A, or may be another indication that overseas findings are not applicable in a New Zealand setting due to the difference in substances available. The observed differences in the results are unlikely to be the result of the small sample size in the current study as medium effect sizes were obtained on the WCST-A measures.

In addition to assessing the obtained scores compared to the normative data, correlations were conducted to assess the relation between scores obtained and methadone prescription. Interestingly, time on methadone was negatively correlated with non-perseverative errors, which suggests that the longer individuals have been on methadone the more non-perseverative errors they make on the WCST-A. This may suggest that long-term methadone use may negatively impact on problem solving ability, or may also suggest that those who remain in treatment are more likely to make mistakes in problem solving.

Overall, the findings for this current sample suggest that while the majority of the sample had no clinically significant impairment in problem solving ability, 5 participants had impairments in this area. This suggests that the majority of individuals in MMT should have no difficulty solving problems in their daily lives provided that they have the resources (e.g. time, money) to solve the given problem. Five of the participants are, however, likely to have noticeable difficulties with problem solving tasks.

Trail Making Test

The TMT was used as a measure of attention, both simple and divided, and cognitive flexibility. It is the most commonly used measure of these cognitive functions in drug and alcohol populations, and impairments in cognitive flexibility as assessed by the TMT have been reported in methadone populations (Avants, Margolin, Warburton, Hawkins, & Shi, 2001; Mintzer & Stitzer, 2002).

In the current study, the Methadone sample did not differ from the normative mean on Part A of the TMT, but obtained poorer scores on the TMT Part B. Individual results showed than 2 of the 15 individuals obtained scores that were more than one standard deviation below the normative mean on TMT Part A, and 9 participants obtained scores that were more than one standard deviation below the normative data on Part B. While the results for the TMT Part B were not normally distributed and should be interpreted with caution, these findings suggest that the majority of individuals were not impaired on simple attention tasks (as assessed by Part A), although almost two thirds of the sample were impaired in their divided attention and cognitive flexibility.

The results for the current sample are comparable to those reported by Avants et al. (2001) and Mintzer and Stitzer (2002). Both of these studies reported impairments on the TMT Part B, and Mintzer and Stitzer (2002) reported impairments on the TMT Part A also. The findings for the current sample on Part A may have differed from those reported by Mintzer and Stitzer (2002) as that study reported on the time taken to complete the TMT Part B in seconds, while the current study used age adjusted normative data. Therefore, the current findings may be a more accurate representation of the simple attention abilities of individuals in MMT, as previous research has suggest that the TMT is susceptible to age effects (Mitrushima, Boone, & D'Elia, 1999).

While the current study used age adjusted normative data for the TMT, the effects of education were not accounted for. In the current sample, years of education were found to positive correlated with the Trail Making B Percentile Score (as number of years of education increases, so to does TMT Part B Percentile score). Previous research using the TMT has reported the same relation between education and the TMT (Strauss, Sherman, & Spreen, 2006). This finding may indicate that scores on the TMT are impacted by level of education.

In this sample there were two surprising findings from the TMT. In the current study significant correlations were obtained between overdoses and scores on the TMT Part B which suggests that, as the number of overdoses increases, individuals obtain better scores on the TMT Part B. This finding is surprising given that the TMT is commonly thought to measure organic brain damage (Reitan, 1986; Tombaugh, 2004). On further examination, this result was found to be the result on one outlier, and when analysis was redone excluding this participant the result was not significant.

Left-handedness was also associated with a better result on the TMT Part B in the current sample, which contradicts previous research which has suggests that left-handed individuals perform more poorly on the TMT (Tupper & Cicerone, 1990). Left-handedness has previously been associated with poorer scores, as it is thought that left-handed individuals inadvertently cover more of the page while completing the TMT, therefore making it more difficult to scan the page for the next letter or number effectively. While the results for this current sample suggest that left-handed individuals obtained better scores on the TMT Part B this result should be interpreted with caution given that the distribution of the data differed significantly from normal, and only 3 participants were left handed. Additionally, given the small sample size this result may be an interaction between a number of variables and not handedness and TMT Part B scores.

Overall, the findings suggest that the majority of individuals were not impaired on simple attention tasks, however, a large percentage of participants were impaired in their divided attention and cognitive flexibility. These impairments are likely to have a significant impact on the effectiveness of treatment sessions at CADS, as these individuals are likely to have difficulty paying attention to several things at once, and then relating this information to their everyday lives (Lezak, 1995). The impairments in attention suggest that information should be provided in a simplified format to allow for increased processing of important information, and that repetition

of this information may be useful given the reported impairments in memory. Treatment sessions could incorporate the use of written handouts to reduce the amount of information individuals need to attend to, address strategies to reduce distraction, and encourage the formulation of a routine to improve memory for tasks that need to be completed, and reduce the need to think about several tasks at once.

Stroop Color & Word Test

The Stroop Color and Word Test was administered as a measure of impulse control and inhibition. The Stroop is one of the few measures available to measure impulse control and inhibition, and has been used in research with drug and alcohol populations. Previous research has suggested that impairments in impulse control and inhibition are more likely in drug and alcohol populations, and that impairments in these areas may account for ongoing substance use by this population (Verdejo-Garcia, Lopez-Torrecillas, Orozco, & Perez-Garia, 2004). Reported impairments in methadone samples using the Stroop have, however, varied, with some studies reporting impairments (Mintzer & Stitzer, 2002; Prosser, Cohen, Steinfeld, Eisenberg, London, & Galynker, 2006; Verdejo, Toribio, Orozco, Puente, & Perez-Garcia, 2005) and others reporting no impairments (Gruber, Tzilos, Silveri, Pollack, Renshaw, Kaufman, & Yurgelun-Todd, 2006).

In the current study, the Methadone sample performed significantly better than the published normative data on the Stroop Interference measure, and in accordance with the normative data on all other measures of the Stroop. These results are contrary to research which has reported impairments in impulse control and inhibition. The results in the current study also suggest that this sample may have inhibition skills better than the general population. As such, it is unlikely that inhibition and impulse control impairments contribute to poor treatment adherence and retention in this sample.

National Adult Reading Test-II

The National Adult Reading Test – 2nd Edition was administered to assess premorbid IQ as this is the most commonly used measure of intelligence in the area of alcohol and substance use research. Previous research has suggested that premorbid IQ scores in methadone samples are lower than those reported in the general population (Avants, Margolin, Warburton, Hawkins, & Shi, 2001; Darke, Sims,

McDonald, & Wickes, 2000; Gruber et al., 2006; Mintzer, Copersino, & Stitzer, 2005; Prosser et al., 2006), and/or may differ from those of the general population prior to the use of substances (Pope Jr., Gruber, & Yurgelun-Todd, 1995).

In the current study, the Methadone sample obtained premorbid IQ scores on the NART-II that were higher than the normative mean, with obtained mean scores in the 111-112 range. These results are well above those reported in previous studies of methadone populations which have reported premorbid IQ scores below the normative means for the respective measures (e.g. Avants, Margolin, Warburton, Hawkins, & Shi, 2001; Darke, Sims, McDonald, & Wickes, 2000; Gruber et al., 2006; Mintzer, Copersino, & Stitzer, 2005; Prosser et al., 2006).

Given the high premorbid IQ scores, previous research suggests that we would expect to see normal or above normal performance on the other administered measures (Lezak, Howieson, Loring, Hannay, & Fisher, 2004). In addition, the results from *Experiment 1* suggested that the measures used may be suitable for use in New Zealand, and we would therefore expect results in line with the normative data. In the current, sample however, significantly poorer results were found on the WMS-III-A, WIAT-II Numerical Operations and Composite score, and all measures of the WCST-A with the exception of Nonperseverative Errors. Therefore, the obtained scores on the NART-II therefore suggest that the poorer results obtained by this sample are likely to represent a significant decrease in functioning ability, even if these results still fall within the normal range. As such, individuals in the MMT programme may report a decrease in functioning ability which is not detected by psychometric tests as this population may have had superior functioning at a prior time.

One particularly interesting finding in this study was the relation between the number of head injuries, and all measures of the NART-II. This relation is surprising given that previous research has suggested that the NART-II is relatively impervious to the effects of brain damage (Darke, Sims, McDonald, & Wickes, 2000; Kelly, Johnson, Knoller, Drubach, & Winslow, 1997; Taylor, Kreutzer, Demm, & M, 2003). This finding suggests that scores on the NART-II may be affected by the number of head injuries, although this result should be interpreted with caution given the small sample size and as the number of head injuries was based on self report which may not be reliable. Recent research also suggests that the NART is not impervious to the effects of sustained TBI, and similar effects have been reported on the WTAR (Bate, Mathias, & Crawford, 2001; Freeman, Godfrey, Harris, & Partridge, 2001; Mathias,

Bigler, Jones, Bowden, Barrett-Woodbridge, Brown, & Taylor, 2004; Mathias, Bowden, Bigler, & Rosenfeld, 2007). This could suggest that measures such as the NART may also be impacted upon by other brain insults, such as substance misuse. Further research is needed to assess this finding.

Wechsler Individual Achievement Test-Abbreviated

In the initial research for this study, reading ability was highlighted as being necessary to understand and comprehend the information provided prior to entry into the MMT programme provided by CADS. Specifically, individuals enrolling in the MMT programme provided by this service are given two documents to read - the CADS Methadone Contract (see Appendix VI) and the New Zealand Methadone Handbook (Howieson, Koning, Burgess, Nixon, & Keays, 2003), which outline the terms and conditions of enrolling in the programme. In addition, information about the methadone programme and consumer responsibilities is provided verbally by staff. However, there are no set guidelines as to what consumers should be told about MMT by staff at CADS, and therefore, the verbal information provided to consumers is likely to vary. Based on the written information provided, it is expected that new consumers to MMT have a Flesch-Kincaid Grade Level reading score of 8.7 for the Methadone Contract and a reading level of 9.4 for the Methadone Handbook (equivalent of a 4th form/Year 10 education level).

As reading ability was considered an important component, the WIAT-II-A was included as a measure of reading and academic ability. Few research studies have assessed the reading ability of drug and alcohol populations, so the WIAT-II-A was selected as it is a well validated and often used measure to assess academic ability. Additionally, it has a short administration time.

The Methadone sample obtained higher scores compared to the normative data on the Word Reading subtest, with the mean score equal to a 7th Form or Year 11 reading level. This was higher than the mean number of years that the sample had completed of formal education (11.4 years, equivalent to having completed 5th Form or Year 11). Analysis of individual results showed that all participants met the minimum 4th Form/Year 10 education level required to read the information provided by CADS. These results indicate that the sample were unlikely to have difficulty with reading and comprehension of the information provided about the MMT programme.

In addition to the Word Reading measure, the WIAT-II-A also assessed mathematics and spelling abilities. On the Numerical Operations subtest the Methadone sample obtained poorer scores compared to the normative data, with a mean score indicating that the sample had a Form 1/Year 7 mathematics understanding. On the Spelling subtest, the Methadone sample did not differ from the normative data, and obtained a mean score indicating that the sample had a 5th Form/Year 11 understanding of spelling. The overall Composite score for the Methadone sample was significantly lower than the normative mean, however, this was largely due to the Numerical Operations scores.

Overall, the results for the WIAT-II-A suggest that the current sample is unlikely to have difficulty reading information provided by CADS, and is unlikely to have difficulty participating in aspects of the MMT programme that require reading ability. The findings on the Word Reading subtest are comparable to those obtained on the NART-II, also a measure of reading, which further supports the higher premorbid functioning ability in this sample. However, the sample is likely to have difficulty with tasks requiring mathematics skills above a Form 1/Year 7 level. Given that the sample had basic mathematics skills (e.g. addition and subtract) these skills are unlikely to have a significantly impacted on the daily requirements of the MMT programme.

Beck Anxiety Inventory & Beck Depression Inventory-II

In the current study, the Methadone sample obtained a mean BDI-II score of 17.4 (SD 11.06), with the largest percentage of the sample falling in the minimal range for symptomology (40%), followed by mild (26.67%), severe (20%), and moderate (13.33%). The mean BDI-II score obtained by the Methadone sample is similar to those reported by Wasserman et al. (2001) and Ersche et al. (2006). The obtained BDI-II results were also significantly higher than those obtained by the University Control sample reported in *Experiment 1* (8.53, SD 6.87), which concurs with the research suggesting higher psychiatric rates in alcohol and drug populations (Callaly, Trauer, Munro, & Whelan, 2001; Kokkevi & Stefanis, 1995; Marsden, Gossop, Stewart, Rolfe, & Farrell, 2000; Milby, Sims, Khuder, Schumacher, Huggins, McLellan, Woody, & Haas, 1996).

One surprising finding on the BDI-II was the positive correlation with the Logical Memory I and II subtests of the WMS-III-A, which suggests that the more

depressed someone is, the better they perform at short-term verbal recall. This finding contrasts with previous research that suggests that depression is usually associated with a decrease in memory ability (e.g. Gilewski, Zelinski, & Schaie, 1990; Zakzanis, Leach, & Kaplan, 1998), and as such may be the result of an interaction between a number of variables and not the depression and memory scores.

BDI-II scores were also found to negatively correlate with the Stroop Colour-Word T-Score. This finding suggests that the more depressed an individual is, the more difficulty they have in naming the colour of a word when it is different from the word that is printed. The finding regarding colour-word naming ability coincides with the research that depression affects neuropsychological performance (Aharonovich, Hasin, Brooks, Liu, Bisaga, & Nunes, 2005; Landro, Stiles, & Sletvold, 2001; Porter, Gallagher, Thompson, & Young, 2003), although no studies with MMT populations appear to have reported a relationship between depression and impairment in colour-naming ability. It should be noted that participants with lower scores on the Stroop Colour-Word T-Score did, however, still obtain scores within the normal range.

No studies appear to have assessed the use of the BAI in MMT populations. In the current study, the Methadone sample obtained a mean BAI score of 19.20 (SD 10.81), with the largest percentage of the sample falling in the severe range for symptomology (33.33%), followed by the mild and moderate ranges (both 26.67%) and the minimal range (13.33%). The BAI mean score was higher than that reported in the normative data, and higher than that obtained by the University Control sample in *Experiment 1* (11.08, SD 9.10). This concurs with the research regarding higher rates of psychiatric disorders in alcohol and drug populations compared to the general population (Kandel, Huang, & Davies, 2001; Sunderland, Watts, Baddeley, & Harris, 1986; Weaver, Madden, Charles, Stimson, Renton, Tyrer, Barnes, Bench, Middleton, Wright, Paterson, Shanahan, Seivewright, & Ford, 2003).

Previous research with opiate dependent populations has typically used the State-Trait Anxiety Inventory (STAI) to assess anxiety, and have reported higher anxiety rates of anxiety in these populations compared to the general population (Adamson, 1997; Darke, Swift, & Hall, 1994). In particular, Darke et al. (1994) reported that more than 50% of their methadone sample obtained a score that was more than one standard deviation above the normative mean. While the STAI was not used in the current research due to the criticisms surrounding the ability of the STAI to differentiate between anxiety and depression, and findings which also suggest that

the BAI provides a better measure of anxiety (Creamer, Foran, & Bell, 1995), the findings in this study using the BAI concur with the literature to date.

In addition to the analysis of the BAI results in comparison to the normative data, the relation between anxiety and the administered psychometric measures was assessed. The BAI was shown to negatively correlate with the Stroop Colour T-Score and Stroop Colour-Word T-Score. This finding was unexpected, as no previous research appears to have suggested a link between anxiety and the Stroop task in methadone populations. This finding suggests that anxiety may impair colour naming ability in the Methadone sample, although this finding may be at least partially attributable to the impairments in divided attention noted earlier. Alternatively, this finding may suggest that anxiety interferes with the ability to complete the Stroop rather than indicating a specific relationship between colour-naming and anxiety.

Number of overdoses was found to positively correlate with the BAI score. This finding suggests that as the number of overdoses increases, so do the symptoms of anxiety. This could suggest that individuals that overdose are more anxious, or alternatively that overdosing results in higher levels of anxiety. However, as correlations are not evidence of causality, further research is needed to assess this finding. These results should also be interpreted with caution given the small sample size, and as reported overdoses were based on self-report.

While the above results suggest elevated rates of both anxiety and depression in the current Methadone sample, caution should be taken in the interpretation of the results. Following the literature review, and in consultation with the participants in this study, it was found that a number of the common side effects of methadone resemble those asked about in relation to anxiety in the BAI and depression in the BDI-II. For example, commonly reported side-effects of methadone include sweating, shallow breathing, constipation, dizziness, dry mouth, sexual dysfunction, body aches, bone problems, appetite loss, nausea, insomnia, weight changes, and tiredness/drowsiness (Goldsmith, Hunt, Lipton, & Strung, 1984; Medsafe, 2005). Similarly, the BAI assesses the symptoms of sweating, difficulty breathing, dizziness or light-headedness, while the BDI-II assesses aspects such as changes in sleep patterns, and loss of interest in sex.

Thus, it is difficult to determine if the symptoms that individuals report are side-effects of methadone, or are symptoms of an underlying anxiety disorder. The side-effects commonly reported may also account, at least in part, for the high rates of

benzodiazepine prescription in this population if the side-effects of methadone are mistakenly attributed to an anxiety disorder.

Treatment Perceptions Questionnaire

In addition to the psychometric measures, individuals in the Methadone sample completed the Treatment Perceptions Questionnaire (TPQ) to assess satisfaction with treatment. On this measure, the Methadone sample obtained a mean score of 23.15 (SD 5.82) from a possible maximum score of 40 (higher scores indicate greater treatment satisfaction). This finding is similar to that reported by Deering et al. (2003) who reported a mean TPQ score of 22.7 (SD 8.6) in a sample of 93 individuals in MMT in Christchurch New Zealand. Similarly, Strang, Marsden, Cummins, Farrell, Finch, Gossop, Stewart and Welch (2000) reported an average TPQ score of 22.6 (SD 7.7) in a sample of 15 individuals, in South London, who were receiving oral methadone.

Overall, the results from the TPQ suggested dissatisfaction with the MMT programme, with participants in this sample reporting that they had not received the type of help they wanted; that staff had different ideas about what treatment should involve; and that they did not like the treatment rules and regulations. Participants also reported that MMT as a treatment option resulted in a loss of freedom (e.g., requirement to consume dose under supervision on a regular basis); that they were condemned for attempts to reduce illicit use as they were ‘treated like children’; and that the consequences of not complying with the treatment programme were inconsistent. These findings are similar to those reported by Deering et al. (2003).

In the current study, perceptions of treatment as outlined in the TPQ total score and TPQ Program Perceptions factor differed between those who attended both of their two most recently scheduled appointments, and those who attended only one of their two most recently scheduled appointments. This suggests that satisfaction with treatment may be related to appointment attendance, however, it is unclear if individuals do not attend their appointments due to dissatisfaction with the treatment service and the type of treatment that is available, or if individuals are less satisfied with the treatment service and the type of treatment available due to lack of attendance at appointments. Further research is needed to assess the relation between client dissatisfaction with treatment services and poor adherence in programmes run by these services.

Neuropsychological Performance & Treatment Adherence

As discussed previously, one of the aims of the research was to assess the cognitive functioning of individuals in MMT in relation to their adherence to the treatment programme. In the current study, treatment adherence was measured by attendance at scheduled doctors' appointments and the number of missed doses of methadone. As mentioned in the *Results* section, of the 15 individuals in the Methadone sample, 11 had attended their two most recent appointments while the remaining 6 had attended one of the two most recently scheduled appointments. None of the sample had missed consumption of their dose of methadone within the last month.

In the current study, there were no significant differences found between those participants who had attended their two most recent appointments, and those participants who had attended one of the last two most recent appointments on any of the psychometric measures. Scores on the TPQ total score and TPQ Program Perceptions factor score were, however, found to be lower for those participants who had attended 1 of the 2 most recently scheduled appointments. While there were no statistically significant differences found on any of the psychometric measures, there were medium and large effect sizes obtained for a number of the measures. These effect sizes suggest that, with a larger sample, differences may have been seen on the measures on long-term verbal memory, academic ability with the exception of spelling, impulse control, depression, verbal intelligence, and some aspects of problem solving. Interestingly, the participants who had attended only one of the two most recently scheduled appointments obtained higher (better) mean scores compared to those participants who attended both the last two scheduled appointments on all of these measures, with the exception of the depression score. The depression score in this group also indicated that this group had lower levels of depression that the participants who had attended both of their appointments.

The findings for the current study suggest that poorer cognitive functioning is not related to poorer treatment adherence. In fact, the findings suggest that better cognitive functioning is associated with poorer treatment adherence. This finding contrasts with previous literature which has suggested that cognitive impairments are likely to be associated with poorer treatment adherence (Aharonovich, Nunes, & Hasin, 2003; Blume, Schmalinga, & Marlatt, 2005; Fals-Stewart, 1993; Fals-Stewart & Lucente, 1994; Fals-Stewart & Schafer, 1992; Fals-Stewart, Schafer, Lucente,

Rustine, & Brown, 1994; Kleber, Weiss, Anton, Rounsaville, George, Strain, Greenfield, Ziedonis, Kosten, Hennesey, O'Brien, Smith Connery, McIntyre, Charles, Anzia, Nininger, Cook, Summergrad, Finnerty, Woods, Johnson, Yager, Pyles, Cross, Walker, Peele, Barnovitz, Hafler Gray, Shemo, Saxena, Tonnu, Kunkle, Albert, Fochtmann, Hart, & Regier, 2006; Miller, 1991; Teichner, Horner, Roitzsch, Herron, & Thevos, 2002; Verdejo-Garcia, Lopez-Torrecillas, Orozco, & Perez-Garia, 2004; Weinstein & Shaffer, 1993; Woods, Freitas, & Fas-Stewart, 1999). The contrasting results reported in the current study could be a result of a bias sample as only those individuals who arrived for the research assessment were included in analysis, and as such may not be representative of the larger MMT population. The fact that the participation in the research was voluntary may also mean that the sample is not representative. Previous research has addressed the issue of recruitment by offering incentives (e.g., Block, Erwin, & Ghoneim, 2002), or by incorporating research as a compulsory component of treatment (e.g. Blaney & Craig, 1999; Fals-Stewart & Bates, 2003; Fals-Stewart, 1997). These approaches were not possible in the current research. The obtained results could also suggest that those with increased difficulties were more likely to attend the service in the aim of receiving assistance, hence the better treatment attendance in those with poorer cognitive functioning.

The adherence measure used in the research was additionally limited by the information that is routinely collected by the Community Alcohol and Drug Service, and as such may not truly represent treatment adherence in this population. This is likely to have particularly influenced the current results, given that poorer adherence as measured in this study was associated with higher scores on the psychometric measures. Future studies aiming to assess adherence may find that using a number of adherence measures may produce a different result. Ultimately, the best way to achieve this is through a longitudinal approach that is incorporated in initial enrolment in treatment, and therefore able to assess several aspects of predefined adherence.

Relation between methadone and psychometric results

The relation of methadone dose to the neuropsychological test results was assessed as some previous research has suggested that higher doses of methadone may be associated with greater impairment (e.g. Rapeli et al., 2007). In contrast, other research has reported no correlation between methadone dose and impairment (Darke,

Sims, McDonald, & Wickes, 2000). In the current study, the dose of methadone was not found to correlate with the scores on any of the psychometric measures.

Time on MMT was negatively correlated with Nonperseverative Errors on the WCST-A. This finding suggests that longer treatment episodes are associated with less non-perseverative errors, which in the context of a problem solving task could suggest a greater understanding of the task. However, as a similar pattern was not evident on the perseverative errors measure, interpretation of this result is difficult. This finding may also be a result of other factors, such as increased time to learn problem solving strategies, as individuals who have been in methadone treatment for a longer duration are invariably older.

In addition the length of time on methadone was assessed as previous research has suggested a link between cognitive impairment and time of methadone dose administration also (e.g. Curran, Kleckham, Bearn, Strang, & Wanigaratne, 2001). In the current study, significant correlations were found between the length of time since last dose and the WMS-III-A Family Pictures I and Family Pictures II subtests. This finding suggests that methadone itself may contribute to impairments in the memory functioning of this population, and as such memory may improve once individuals are no longer in an MMT programme. Research assessing the cognitive functioning of individuals both in treatment, and following cessation of treatment could explore this finding further.

Limitations

The current sample was recruited from CADS in Hamilton which, at the time of the research, provided a MMT programme for approximately 220 individuals. The research was available to all individuals who had been on the methadone programme provided by this service for at least three months. While this encompassed almost all of the individuals on the methadone programme at this service, only 15 individuals were interviewed, from a total of 46 individuals who agreed to be contacted.

Therefore, the Methadone sample includes less than 10% of the population being studied, making it a small sample which may not be representative of the wider population for several reasons. Firstly, individuals were recruited on a voluntary basis through the treatment service so it only included those individuals who visited the service (turned up for appointments within the recruitment period) or who heard about the research from other individuals at the treatment service. Secondly, while 46

individuals agreed to be contacted about participation in the research, only those individuals who arrived for the appointments were interviewed. Comparing the present Methadone sample with individuals who did not arrive for appointments, and with the greater population would have been useful in determining whether the sample was representative of the wider population. However, this was not possible due to the need for informed consent. As such, it is possible that the Methadone sample in this study only included those individuals who attended the service on a regular basis, and who may, therefore, have less significant impairments. However, this is difficult to determine.

Secondly, the use of financial incentives was restricted as previous research with drug and alcohol populations has suggested that financial incentives could aid in continued drug-seeking behaviour, and could, therefore, be considered to be coercion (Cunningham, 1998; Galanter & Kleber, 1999; McCrady & Bux Jr., 1999). Therefore, the limited incentives offered in the current research may have resulted in the low number of individuals recruited for this study.

Finally, the administration of the current research took approximately 1 ½ to 2 hours to complete. This lengthy administration time may have reduced the number of individuals willing, or in fact able, to participate due to other commitments. While the required time to participate in the research was considerably shorter that other research studies (e.g. Fals-Stewart, 1997; Fields & Fullerton, 1975; Morris & Lawson, 1998), these other research studies have been able to offer incentives for participation.

While the current study has several limitations, there are also a number of strengths.

Strengths

Previous research in the area of drug use and cognitive functioning has attempted to control for a wide range of variables which may influence the outcome of testing. The resulting sample is often far removed from the study population, and the results obtained with this sample are often not applicable to the wider population.

In the current study, individuals were not excluded from the research unless they were deemed to be intoxicated at the time of administration, or were considered to be mentally unstable at the time of assessment. The aim of this was to obtain a sample that was representative of the population being sampled, while also allowing for confounding variables such as head injuries and overdoses to be assessed. For

example, results in the current study found that performance on the TMT decreased with number of overdoses. Another surprising finding was that the number of head injuries was correlated with all measures of the NART-II (all negative). These findings provide further information about the actual population which is seen in treatment services.

In addition, the current research included a measure of premorbid functioning to assess for differences between expected and obtained levels of functioning. Some previous research has been criticised for failing to account for premorbid functioning, and other research has reported premorbid functioning rates lower that the general population, the current research found that the sample had a significantly higher premorbid IQ. This suggests that findings for this study even if within the normal range, or slightly below the normal range, when compared to the normative data, may represent a significant decrease in functioning for these individuals. The higher premorbid IQ scores in this sample may also suggest a difference in the premorbid functioning ability of methadone samples within New Zealand compared to those studied overseas. Therefore, cognitive impairments may not be reported within New Zealand samples populations as frequently. Further research is needed to examine the findings of this study.

Overall Findings

As discussed previously, the results from this study suggest that the Methadone sample had impairments in their memory, in divided attention and cognitive flexibility, and performed below the expected range for mathematical ability compared to the normative data. When comparing the results for these measures to the normative data, the overall sample means were still within one standard deviation of the normative means. However, the disparity between the NART-II scores (premorbid functioning estimate) and the psychometric measures suggests that there was a decline in functioning for this population even though scores on the psychometric measures did not fall more than one standard deviation below the normative data mean.

By contrast, this sample obtained higher (better) scores on the measures of inhibition/impulse control, reading ability and premorbid functioning than the normative data. The findings concerning inhibition/impulse control were particularly surprising given that the literature has suggested that impulse control and inhibition in this population are likely to be impaired.

While the current study aimed to assess the relation between adherence to treatment and psychometric test results, no relation was found for any of these measures, although effect sizes suggested that higher, and therefore better, scores on several psychometric measures were associated with poorer adherence. Poor adherence was, however, found to be related to poorer treatment satisfaction.

While the results from this study provide some interesting findings, the research findings are limited in a number of ways, as outlined previously. There are a number of recommendations that can be made from this present study.

Recommendations

Based on the findings of this study, further research is needed to address the cognitive functioning of individuals in MMT in New Zealand. Further research is needed due to a number of possible limitations in the current sample as outlined previously. The current study suggests that there may be impairments in memory, divided attention and cognitive flexibility.

In order to assess the cognitive functioning of this population further, it was decided to extend the current study with the intention of gaining more participants to add further support to the results from this study. Due to the difficulties in recruiting participants for this study, and as a number of the psychometric measures found no impairments in their respective areas of functioning when compared with the normative data, it was decided to reduce the battery of tests administered. The measures that were removed from the battery were the WIAT-II-A, BAI, BDI-II and the NART-II. The removal of these tests is discussed below.

The WIAT-II-A was originally included in the test battery to assess reading ability in the current sample, as a review of the Community Alcohol and Drug Service found that individuals required a reading level equivalent to a 4th Form/Year 10 education to read the two documents provided prior to commencing on the MMT programme. In the current study, all individuals in the sample obtained a Word Reading score on the WIAT-II-A above the minimum 4th Form/Year 10 education level which suggested that the methadone population is unlikely to have difficulty reading the information provided. Given that the individuals in the current study had no difficulty with reading ability and that the scores obtained on the other WIAT-II-A subtests (Numerical Operations and Spelling) were not considered to be relevant to MMT, the WIAT-II-A was removed from the test battery.

The BAI and BDI-II were included in the current study to assess the effects of anxiety and depression on the neuropsychological measures administered. Overall the BAI and BDI-II were not found to correlate with the psychometric measures, and in the few cases that they did these findings were often contrary to previous research findings. In addition, a number of the common side effects of methadone resemble symptomology that is asked about on the BAI and on the BDI-II. This made it difficult to assess whether these measures were assessing anxiety and depression. Therefore, the BAI and BDI-II were removed from the test battery.

The other measure removed from the test battery was the National Adult Reading Test-II. As discussed previously, this was included as an estimate of premorbid IQ as previous research has been criticised for not assessing premorbid functioning. In the current study, the Methadone sample obtained mean NART-II scores in the 111-112 range which were significantly above those of the normative data. Additionally, all participants obtained Full Scale IQ scores equal to or above the normative mean. As the sample showed no impairment in premorbid IQ, the NART-II was removed from the test battery.

The measures that remained in the test battery were the WMS-III-A, TMT, Stroop Colour and Word Test and the WCST-A. The total time required to administer the remaining measures was approximately 45 minutes.

In addition to the reduction in psychometric measures, the number of agencies through which participants were to be recruited was extended. In addition to recruiting participants through CADS, the Needle Exchange Service in Hamilton was included as a recruitment location with the aim of recruiting individuals who were enrolled in the MMT programme at CADS, but who were not attending their appointments at that service. It was hoped that this would increase the total number of individuals that were recruited, as well as recruiting individuals who were not adhering to treatment. In turn, this would allow further analysis of the relation between cognitive impairments and treatment adherence. The data from the Second Methadone sample is reported in the next study (*Experiment 4*).

EXPERIMENT 4

Experiment 4 aimed to gain more participants from the MMT programme at CADS in order to extend the sample. As mentioned previously, it was decided that the research approach would be modified in a number of ways. In this study, the number of psychometric measures administered was reduced with the aim of recruiting more participants to provide a more representative sample, and to assess the cognitive functioning of individuals in MMT further. In addition, the Needle Exchange in Hamilton was included as a recruitment location in an attempt to contact those people enrolled in MMT who were not attending their appointments.

METHOD

Participants

Following the completion of *Experiment 3*, and the modifications to the research approach, CADS in Hamilton was approached a second time regarding participation in this research. The CADS management agreed to participate in the research, and agreed that a reduction in the measures used and extension of the recruitment locations would be beneficial in recruiting more participants. In addition, the overall research approach was discussed with staff as there were a number of new staff members that had joined the service since the completion of *Experiment 3*.

As a result, a total of 14 individuals were interviewed from a pool of 16 who agreed to be contacted. The remaining two individuals either did not arrive for an arranged appointment, or were unable to be contacted. All 14 participants were enrolled in the MMT programme at CADS, and 11 of these participants were recruited through this service. The remaining three participations were recruited through the Needle Exchange Service in Hamilton.

Materials

As discussed previously, the psychometric measures administered to each participant were the Stroop Color and Word Test, Trail Making Test, Wechsler Memory Scale-III-Abbreviated and the Wisconsin Card Sorting Test-Abbreviated.

Further details of these psychometric tests are provided in *Experiment 1*. Participants also completed the Treatment Perceptions Questionnaire, the details of which are available in *Experiment 3*. The adherence measures and interview outline used in *Experiment 3* were also used with this sample.

Procedure

Prior to the commencement of this research, ethical approval was obtained from the Psychology Department Human Research Ethics Committee at the University of Waikato and the Northern Y Regional Ethics Committee (part of the Health and Disability Ethics Committee).

Participants were recruited through CADS and the Needle Exchange Service in Hamilton between January 2007 and December 2007. All individuals were on the MMT programme that is run by CADS. Participants were recruited through information fliers posted at CADS and at the Needle Exchange Service (see Appendix VII), and through information provided by service staff to consumers of these services.

Individuals who agreed to take part in the research, were provided with the information sheet about the research (see Appendix XII), and one they had completed the necessary consent forms (see Appendix XIII) they were administered the psychometric tests. They were asked a short series of questions regarding recent substance/alcohol use, and previous head injuries also (see Appendix X). The psychometric tests were administered in a fixed sequence by the researcher, as listed below.

Wechsler Memory Scale III – Abbreviated (WMS-III-A) (Logical Memory I & Family Pictures I)
Trail Making Test (TMT)
Stroop Color and Word Test
Wisconsin Card Sorting Test – Abbreviated (WCST-A)
Wechsler Memory Scale III – Abbreviated (WMS-III-A) (Logical Memory II & Family Pictures II)

The Treatment Perceptions Questionnaire was provided to participants at the end of the test sequence. All interviews were conducted on a one on one basis in a

room at CADS, or at the Needle Exchange Service and took approximately 45 minutes to complete. All other aspects of the procedure were identical to the procedure in *Experiment 3.* Following the completion of the assessment, individual participation was recorded in the individuals file at CADS (see Appendix XIV).

Scoring and data entry

Scoring and data entry were conducted as outlined in *Experiment 1*. As in *Experiment 3*, participants in the current study were given the option of receiving feedback on the results of the testing, and if participants agreed, this information was provided for inclusion in their case notes at CADS.

Analysis was conducted using SPSS Version 12, and was based on the same psychometric scores outlined in *Experiment 1*. Analysis of the Treatment Perception Questionnaire was conducted as outlined in *Experiment 3*.

RESULTS

This study aimed to increase the size of the sample of individuals in MMT, and to assess the cognitive functioning of individuals receiving MMT in New Zealand further. The participants in this study had a mean age of 37.72 years, and were predominantly of New Zealand European descent, as shown in Table 4.1. There were a greater number of males than females, and the sample had completed the equivalent of 6th Form or Year 12/NCEA Level 2. The participants had been in the current episode of treatment for opiate dependence 8.3 years on average, and the mean prescribed methadone dose was 87.36 mg daily. Nine participants had received treatment for opioid dependence previously, with the mean number of treatment

Table 4.1

Demographic details of Second Methadone Sample

Age	37.72	SD 7.01, Range 28-49
Gender		
Male	9	64.30%
Female	5	35.70%
Handedness		
Left	2	14.30%
Right	12	85.70%
Education	12.57 years	SD 3.01, Range 9-17
Ethnicity		
NZ European/Pakeha	10	71.40%
Maori	1	7.10%
Maori/European	2	14.30%
Other European	1	7.10%
Methadone Maintenance		
Time in Program	8.3 years	SD 7.1, Range 3 months-22 years
Previous Treatment	2.07	SD 2.09, Range 0-6
Present dose	87.36	SD 48.97, Range 12.5-160
Substance History		
First Drug Use	14.43 years	SD 3.13, Range 11-22
First Opiate Use	20.14 years	SD 5.14, Range 13-32

episodes being 2.07. The age of first substance use was between 11 and 22 years of age, with first opiate use occurring between the ages of 13 and 32 years.

Performance on the psychometric tests

As with the data from the previous experiments, prior to any analysis, Shapiro-Wilks tests were conducted on the data to assess for normality. Results from this analysis suggested that the data for the TMT Part B Percentile Score ($W = 0.597$, df = 13, $p < 0.05$) and the WCST-A Total Number of Errors ($W = 0.854$, df = 11, $p < 0.05$) were significantly different from the normal distribution. Subsequently, transformations were conducted on these measures, and square-root transformations normalised the distribution of scores for both measures. For these measures, the normative population scores were transformed in the same way as the data to allow for comparison using a one-sample t-test.

A series of one sample t-tests was conducted to compare the results obtained with the normative data provided in the administration manuals for each test, with the exception of the TMT. The TMT data were compared to the normative data provided by Tombaugh (2004), as discussed in *Experiment 1*.

The one sample t-tests showed statistically significant differences between the obtained and the normative data for a number of measures. A summary of the results is presented in Table 4.2. The sample obtained significantly lower scores compared to the normative data on all measures of the WMS-III-A (with the exception of the Logical Memory II subtest), the TMT Part A and B Percentile Scores, Stroop Colour T-Score, and all measures of the WCST-A. Medium effect sizes were obtained for the WMS-III-A Logical Memory II subtest, and the TMT Part B, while large effect sizes were obtained for all other measures of the WMS-III-A, the Stroop Colour T-Score, and all measures of the WCST-A with the exception of Total Number of Errors. Results from the Second Methadone sample on all other measures were not statistically significant from the normative sample.

A comparison of the obtained results to the normative standard deviation ranges provided for each measure showed that, while this sample differed significantly from the normative data on a number of measures, the mean scores fell within one standard deviation of the test norm for the majority of measures. The exceptions to this were the mean scores for the WMS-III-A Family Pictures I and Family Pictures II subtests and all index scores, which fell more that one standard

deviation below the normative means. A summary of the means and standard deviations for each measure is provided in Table 4.3.

The data were analysed for each participant to assess whether their scores fell more that one or two standard deviations below the normative mean. Table 4.4 gives the number of individuals whose score fell either one or two standard deviations below the normative mean for each measure. The exception to this is the Trail Making Test where only one standard deviation (16^{th} Percentile) was used. Individual participants are numbered according to the order in which they were recruited. Participants 1-15 were recruited in *Experiment 3*, and so, are not included in this analysis.

This analysis showed that 2 participants obtained scores more that 2 standard deviations below the normative mean on all measures of the WMS-III-A, while an additional 2 participants obtained scores more than two standard deviations below the normative mean on the Family Pictures I and II subtests. Five of the 14 participants obtained scores one standard deviation below the normative means on the TMT Part A, and 9 on TMT Part B at one standard deviation. One participant obtained a score more than two standard deviation lower than the normative mean on the Stroop Colour T-Score and Stroop Colour-Word T-Score, while 3 participants obtained scores more than two standard deviations below the normative mean on the WCST-A Nonperseverative Errors measure. One of these participants also obtained scores more than two standard deviations below the normative mean on most measures of the WCST-A. Overall results showed that each participant was not impaired on more than two of the psychometric tests, with the exception of participant 20.

Relation between demographic and psychometric test results

As in the previous experiments, the degree of relation between psychometric results and gender, handedness, academic achievement, head injuries and overdoses were assessed. Table 4.5 shows that gender was positively correlated with the TMT Part B Percentile Score and the Stroop Interference T-Score (males obtained lower scores). Handedness and academic achievement did not correlate with any of the psychometric measures. Number of head injuries was negatively correlated with the TMT Part A Percentile Score and the WCST-A Nonperseverative Errors measure, while number of overdoses was negatively correlated with the Stroop Colour T-Score.

However, significant correlations for number of head injuries and number of overdoses should be interpreted with caution as these were based on self-report.

The relation between time in methadone treatment, methadone dose, and time since last dose were also assessed. As shown in Table 4.6, time in methadone treatment, methadone dose, and time since last dose were not found to significantly correlate with any of the psychometric measures.

Other Drug Use

Of the 14 individuals in this sample, 4 individuals reported using other substances within the prior 48 hours prior to assessment. Of these 4 individuals, 2 reported cannabis use, 1 reported benzodiazepine use, and 1 reported illicit opiate in the previous 48 hours.

In order to determine the influence of other drug use on psychometric tests results, the sample was split into four groups based on what other drugs the individuals identified as using. Group membership was as follows: no other drug use; alcohol, benzodiazepines; and illicit opiates.

The obtained scores on each of the psychometric test results were assessed using Kruskal-Wallis tests across the four groups with the Second Methadone sample. The results of these tests are outlined in Table 4.7, and show that performance on the psychometric tests were not influenced by the type of other substance used. The results from this analysis should, however, be interpreted with caution given the small number of individuals who reported other drug use.

Satisfaction with Treatment

Results from the Treatment Perceptions Questionnaire were varied (mean 23.43, SD 6.11, range 14-33). General themes regarding the methadone program were evident from the personal opinion section included in the questionnaire. These are outlined below:

- MMT results in a loss of freedom (e.g., requirement to consume dose under supervision on a regular basis) which impacts on work and family commitments
- Individuals in MMT are condemned for attempts to reduce illicit use and may face changes to treatment if illicit use is admitted

- Individuals felt that they were 'treated like children' as they were not provided with options regarding their treatment, and were not considered responsible enough to make informed choices
- MMT provided as the 'only option', with referral to other services or count-down off methadone discouraged
- Program rules are inconsistently applied
- Flexible treatment rules needed to allow individuals to engage in work
- High staff changeover created difficulties for clients
- Difficulty contacting staff in emergencies, specifically doctors at the treatment service
- No specific drug and alcohol after-hours contact available in an emergency

Additionally, individuals had concerns regarding confidentiality (although these related to specific incidents). Some individuals stated that they would like more information provided regarding the side-effects of methadone. Others thought that staff did not understand the process of addiction as well as counsellors who were addicts previously.

An analysis of the individual TPQ questions indicated a lower mean score (lower satisfaction) for one question: 'I have not liked some of the treatment rules or regulations' (1.22, SD 1.12). Analysis using the two factors identified by Marsden et al. (2000) found a slightly higher mean score on the staff perceptions factor (12.29, SD 3.71) compared to the program perceptions factor (11.14, SD 3.59).

Pearson Correlations were conducted to assess the relation between treatment satisfaction as measured by the TPQ and time in the MMT programme and methadone dose. No significant correlations were found between time in treatment and the TPQ Score (r = -0.456), TPQ Staff Perceptions (r = -0.516), or TPQ Program Perceptions (r = -0.303). Similarly, no significant correlations were found between methadone dose and TPQ Total Score (r = -0.294), Staff Perceptions (r = -0.263) or Programme Perceptions (r = -0.269) factors.

Neuropsychological Performance & Treatment Adherence

Adherence to treatment was measured by attendance at scheduled doctors' appointments and the number of missed doses of methadone. Eight of the 14 individuals in the Second Methadone sample had attended their two most recent

appointments, while the remaining six had attended one of the two most recent appointments. None of the participants had missed consumption of their dose of methadone within the last month.

To determine if there were differences between those who adhered to treatment requirements and those that had not, a series of independent sample t-tests and Mann-Whitney U tests were conducted. Both an independent samples t-test and a Mann Whitney U test were conducted for each measure, as data for both groups on several of the measures were not normally distributed. In all cases, both tests showed the same result. Therefore, the independent sample t-test results only, are reported here. These results are outlined in Table 4.8, and show no significant differences, on any of the psychometric measures or the TPQ, between the individuals who attended one appointment, and those who attended two appointments. Medium effect sizes were obtained for the comparison between scores on the TMT Part A Percentile Score, all measures of the Stroop with the exception of the Stroop Interference T-Score, and the WCST-A Perseverative Responses, Perseverative Errors, and Conceptual Level Responses measures.

Neuropsychological Performance across samples

As the current study was conducted to extend the methadone sample obtained in *Experiment 3* in order to gain a more representative sample, a comparison was conducted between the original methadone sample and the methadone sample in this study to identify any differences between the two samples. An independent samples t-test showed that the two samples did not significantly differ in age ($t = -1.042$, $df = 27$, $p > 0.05$), academic achievement ($t = -1.102$, $df = 27$, $p > 0.05$), time in methadone treatment ($t = -1.187$, $df = 27$, $p > 0.05$), or dose of methadone ($t = 0.039$, $df = 27$, $p > 0.05$); while a chi squared test for independence showed that gender ($\chi^2 = 0.358$, $p > 0.05$) and ethnicity ($\chi^2 = 2.484$, $p > 0.05$) were not related to sample membership.

As shown in Table 4.9 and Table 4.10, a series of independent sample t-tests and Mann-Whitney U tests were conducted to assess the difference between the two samples on the psychometric tests. Mann-Whitney U tests were conducted when one or more of the samples differed significantly from the normative distribution. The two Methadone samples scores did not differ significantly on any of the neuropsychological tests, or on the TPQ. Medium effect sizes were obtained on all

measures of the Stroop with the exception of the Word T-Score, and the WCST-A Nonperseverative Errors. On all of these measures the original methadone sample obtained better scores.

TABLE 4.2

One sample t-test comparing Second Methadone Sample to Normative Data, including means, standard deviations, and Cohen's d

	Normative		Second Methadone		t	df	Significance	Cohens
	Mean	SD	Mean	SD				*d*
WMS Logical Memory I	10	3	7.57	3.01	-3.02	13	*	-0.81
WMS Family Pictures I	10	3	6.57	2.44	-5.26	13	*	-1.14
WMS Logical Memory II	10	3	8.17	2.98	-2.13	11	NS	-0.61
WMS Family Pictures II	10	3	6.00	2.92	-4.74	11	*	-1.33
WMS Immediate Memory	100	15	82.57	15.15	-4.30	13	*	-1.16
WMS Delayed Memory	100	15	84.75	15.20	-3.47	11	*	-1.02
WMS Total Memory	100	15	81.75	16.44	-3.85	11	*	-1.22
TMT Part A Percentile	50	34	38th	24.75	-6.51	13	*	-0.34
TMT Part B Percentile	7.07	2.41	5.04	5.31	2.34	12	*	-0.84
Stroop Word T-Score	50	10	46.67	10.73	-1.08	11	NS	-0.33
Stroop Colour T-Score	50	10	40.83	7.72	-4.11	11	*	-0.92
Stroop Colour-Word T-Score	50	10	46.75	13.17	-0.85	11	NS	-0.33
Stroop Interference T-Score	50	10	48.67	10.25	-0.45	11	NS	-0.13
WCST Total Number of Errors	10	3.87	9.32	4.05	15.52	10	*	-0.18
WCST Perseverative Responses	100	10	89.55	14.85	-2.34	10	*	-1.05
WCST Persevertive Errors	100	10	89.82	13.82	-2.44	10	*	-1.02
WCST Nonperseverative Errors	100	10	85.45	16.97	-2.84	10	*	-1.45
WCST Conceptual Level Response	100	10	86.27	18.45	-2.47	10	*	-1.37

* Significant at $p < 0.05$

TABLE 4.3

Means and Standard Deviations for Normative and Second Methadone Samples

	Normative Mean	One Standard Deviation	Methadone Mean	Methadone SD
WMS Logical Memory I	10	3	7.57	3.01
WMS Family Pictures I	10	3	6.57	2.44
WMS Logical Memory II	10	3	8.17	2.98
WMS Family Pictures II	10	3	6.00	2.92
WMS Immediate Memory	100	15	82.57	15.15
WMS Delayed Memory	100	15	84.75	15.20
WMS Total Memory	100	15	81.75	16.44
TMT Part A Percentile	50th	16th	38th	24.75
TMT Part B Percentile	50th	16th	25th	28.21
Stroop Word T-Score	50	10	46.67	10.73
Stroop Colour T-Score	50	10	40.83	7.72
Stroop Colour-Word T-Score	50	10	46.75	13.17
Stroop Interference T-Score	50	10	48.67	10.25
WCST Total No Errors	100	15	86.91	16.43
WCST Perseverative Responses	100	15	89.55	14.85
WCST Persevertive Errors	100	15	89.82	13.82
WCST Nonperseverative Errors	100	15	85.45	16.97
WCST Conceptual Level Response	100	15	86.27	18.45

Table 4.4

Number of individuals obtaining scores One and Two Standard Deviations below norm

	n	1 SD	2 SD
WMS Logical Memory I	14	5	2 [17,22]
WMS Family Pictures I	14	6	3 [17,20,22]
WMS Logical Memory II	12	1	2 [17,22]
WMS Family Pictures II	12	4	4 [17,20,22,28]
WMS Immediate Memory	14	4	3 [17,20,22]
WMS Delayed Memory	12	4	2 [17,22]
WMS Total Memory	12	4	3 [17,20,22]
TMT Part A Percentile	14	5 [18,19,23,24,27]	
TMT Part B Percentile	14	9 [17,18,19,20,22,23,26,27,28]	
Stroop Word T-Score	14	4	0
Stroop Colour T-Score	14	4	1 [28]
Stroop Colour-Word T-Score	14	3	1 [28]
Stroop Interference T-Score	14	3	0
WCST Total Number of Errors	12	5	1 [23]
WCST Perseverative Responses	12	3	1 [27]
WCST Persevertive Errors	12	3	1 [27]
WCST Nonperseverative Errors	12	3	3 [19,20,23]
WCST Conceptual Level Response	12	4	2 [19,27]

17,19,20,22,23,27,28 = Methadone Participants 17, 19, 20, 22, 23, 27 and 28 respectively

Table 4.5

Correlations between demographic and psychometric test results for the Second Methadone Sample

	Correlation Coeffient (r)				
	Point Biserial	Point Biserial	Pearsons	Point Biserial	Point Biserial
	Gender	Handedness	Years of Education	Head Injury	Overdose
WMS Logical Memory I	0.213		0.251	0.146	-0.464
WMS Family Pictures I	0.326		0.151	0.137	-0.433
WMS Logical Memory II	0.454		0.515	0.166	-0.245
WMS Family Pictures II	0.505		0.163	0.162	-0.319
WMS Immediate Memory	0.297		0.230	0.157	-0.450
WMS Delayed Memory	0.534		0.369	0.149	-0.285
WMS Total Memory	0.472		0.369	0.176	-0.363
TMT Part A Percentile	0.316	0.312	0.071	**-0.562***	-0.057
TMT Part B Percentile	**0.671***	-0.179	0.237	-0.320	-0.260
Stroop Word T-Score	0.212			-0.261	0.321
Stroop Colour T-Score	0.159			0.443	**-0.778***
Stroop Colour-Word T-Score	0.519			0.043	-0.574
Stroop Interference T-Score	**0.582***			-0.065	-0.441
WCST Total Number of Errors	0.512			-0.551	-0.272
WCST Perseverative Responses	0.409			0.071	-0.170
WCST Persevertive Errors	0.442			0.043	-0.219
WCST Nonperseverative Errors	0.475			**-0.647***	-0.203
WCST Conceptual Level Response	0.466			-0.385	-0.273

* Significant at $p < 0.05$

Table 4.6

Correlation between methadone and psychometric results for the Second Methadone Sample

	Correlation Coeffient (r)		
	Pearsons	Pearsons	Pearsons
	Time in Treatment	Methadone Dose	Time Since Dose
WMS Logical Memory I	-0.024	-0.251	0.379
WMS Family Pictures I	-0.073	-0.143	0.279
WMS Logical Memory II	-0.036	-0.413	0.071
WMS Family Pictures II	-0.181	-0.229	0.377
WMS Immediate Memory	-0.032	-0.223	0.322
WMS Delayed Memory	-0.092	-0.335	0.228
WMS Total Memory	-0.159	-0.363	0.223
TMT Part A Percentile	0.101	0.059	-0.107
TMT Part B Percentile	-0.099	-0.468	-0.039
Stroop Word T-Score	-0.231	-0.103	0.170
Stroop Colour T-Score	-0.111	-0.489	-0.205
Stroop Colour-Word T-Score	0.105	-0.386	-0.292
Stroop Interference T-Score	0.12	-0.469	-0.369
WCST Total Number of Errors	-0.222	-0.174	0.152
WCST Perseverative Responses	0.058	-0.110	0.278
WCST Persevertive Errors	0.028	-0.224	0.166
WCST Nonperseverative Errors	-0.195	-0.085	0.101
WCST Conceptual Level Response	-0.106	-0.123	0.095

* Signficant at $p < 0.05$

Table 4.7

Kruskal Wallis Test for effects of other substance use for the Second Methadone Sample

	No Other Use			Cannabis Use			Benzodiazepine Use		Illicit Opiate Use		Chi-Square	df	Assump Sig
	n	Mean	SD	n	Mean	SD	n	Mean	n	Mean			
WMS Logical Memory I	10	7.50	3.21	2	10.00	0.00	1	4.00	1	7.00	4.35	3	NS
WMS Family Pictures I	10	6.60	2.50	2	8.50	0.71	1	3.00	1	6.00	5.43	3	NS
WMS Logical Memory II	8	8.63	3.11	2	9.00	0.00	1	3.00	1	8.00	3.81	3	NS
WMS Family Pictures II	8	6.00	3.02	2	8.50	0.71	1	2.00	1	5.00	4.95	3	NS
WMS Immediate Memory	10	82.60	15.49	2	95.00	1.41	1	60.00	1	80.00	4.44	3	NS
WMS Delayed Memory	8	86.00	15.61	2	93.50	2.12	1	59.00	1	83.00	4.99	3	NS
WMS Total Memory	8	82.13	17.22	2	93.50	2.12	1	57.00	1	80.00	4.17	3	NS
TMT Part A Percentile	10	36.10	19.51	2	12.50	3.54	1	60.00	1	90.00	3.90	3	NS
TMT Part B Percentile	10	22.00	23.07	1	10.00	.	1	10.00	1	90.00	3.74	3	NS
Stroop Word T-Score	8	42.63	8.80	2	49.00	14.14	1	60.00	1	61.00	4.12	3	NS
Stroop Colour T-Score	8	39.13	6.75	2	44.50	4.95	1	33.00	1	55.00	3.37	3	NS
Stroop Colour-Word T-Score	8	45.38	10.57	2	39.00	11.31	1	44.00	1	76.00	2.63	3	NS
Stroop Interference T-Score	8	49.25	8.43	2	38.00	1.41	1	45.00	1	69.00	2.76	3	NS
WCST Total Number of Errors	7	82.14	15.17	2	87.50	21.92	1	94.00	1	112.00	2.87	3	NS
WCST Perseverative Responses	7	87.43	17.15	2	90.00	14.14	1	89.00	1	104.00	1.32	3	NS
WCST Persevertive Errors	7	88.86	14.83	2	87.50	19.09	1	87.00	1	104.00	1.34	3	NS
WCST Nonperseverative Errors	7	80.14	15.40	2	84.50	20.51	1	99.00	1	111.00	3.84	3	NS
WCST Conceptual Level Response	7	81.57	16.20	2	84.00	28.28	1	96.00	1	114.00	3.16	3	NS

*Significant at $p < 0.05$

Table 4.8

Independent Samples t-test comparing attendence at doctors appointments in Second Methadone Sample, including means, standard deviation, and Cohen's d

	One appointment			Two appointments						Cohens
	n	Mean	SD	n	Mean	SD	t	df	Significance	*d*
WMS Logical Memory 1	6.00	7.33	2.25	8.00	7.75	3.62	-0.25	12	NS	-0.13
WMS Family Pictures 1	6.00	6.83	2.86	8.00	6.38	2.26	0.34	12	NS	0.18
WMS Logical Memory 2	5.00	8.40	1.82	7.00	8.00	3.74	0.22	10	NS	0.13
WMS Family Pictures 2	5.00	6.60	3.44	7.00	5.57	2.70	0.58	10	NS	0.34
WMS Immediate Memory	6.00	83.00	14.09	8.00	82.25	16.87	0.09	12	NS	0.05
WMS Delayed Memory	5.00	87.00	14.27	7.00	83.14	16.76	0.42	10	NS	0.24
WMS Total Memory	5.00	84.00	15.70	7.00	80.14	17.99	0.38	10	NS	0.23
TMT Part A Percentile	6.00	46.17	29.60	8.00	32.38	20.46	1.03	12	NS	0.56
TMT Part B Percentile	5.00	33.40	32.52	8.00	20.38	26.18	0.80	11	NS	0.45
Stroop Word T-Score	5.00	50.20	9.20	7.00	44.14	11.70	0.96	10	NS	0.56
Stroop Colour T-Score	5.00	44.80	10.18	7.00	38.00	4.20	1.61	10	NS	0.94
Stroop Colour-Word T-Score	5.00	51.20	17.50	7.00	43.57	9.25	0.99	10	NS	0.58
Stroop Interference T-Score	5.00	50.40	13.48	7.00	47.43	8.20	0.48	10	NS	0.28
WCST Total Number of Errors	4.00	91.25	19.19	7.00	84.43	15.69	0.64	9	NS	0.40
WCST Perseverative Responses	4.00	96.00	14.17	7.00	85.86	14.95	1.10	9	NS	0.69
WCST Persevertive Errors	4.00	95.75	15.26	7.00	86.43	12.84	1.09	9	NS	0.68
WCST Nonperseverative Errors	4.00	88.75	20.60	7.00	83.57	16.01	0.47	9	NS	0.29
WCST Conceptual Level Response	4.00	92.75	19.31	7.00	82.57	18.35	0.87	9	NS	0.55
TPQ Total Score	6.00	24.00	6.13	8.00	23.00	7.29	0.27	12	NS	0.15
TPQ Staff Perceptions	6.00	12.67	3.44	8.00	12.00	4.11	0.32	12	NS	0.17
TPQ Program Perceptions	6.00	11.33	4.03	8.00	11.00	3.51	0.17	12	NS	0.09

* Significant at p< 0.05

Table 4.9

Independent Samples t-test comparing Methadone and Second Methadone Samples, including means, standard deviations, and Cohen's d

	Methadone		Second Methadone					Cohens
	Mean	SD	Mean	SD	t	df	Significance	*d*
WMS Logical Memory 1	9.00	3.23	7.57	3.01	1.23	27	NS	0.46
WMS Family Pictures 1	7.40	2.50	6.57	2.44	0.90	27	NS	0.34
WMS Logical Memory 2	8.80	3.34	8.17	2.98	0.51	25	NS	0.20
WMS Family Pictures 2	7.27	3.13	6.00	2.92	1.08	25	NS	0.42
WMS Immediate Memory	89.53	14.03	82.57	15.15	1.28	27	NS	0.48
WMS Delayed Memory	89.73	14.81	84.75	15.20	0.86	25	NS	0.33
WMS Total Memory	88.73	14.14	81.75	16.44	1.19	25	NS	0.46
TMT Part A Percentile	48.67	26.15	38.29	24.75	1.10	27	NS	0.41
Stroop Word T-Score	46.21	11.27	46.67	10.73	-0.10	24	NS	-0.04
Stroop Colour T-Score	45.57	8.16	40.83	7.72	1.51	24	NS	0.59
Stroop Colour-Word T-Score	54.93	9.59	46.75	13.17	1.83	24	NS	0.72
Stroop Interference T-Score	54.86	6.74	48.67	10.25	1.84	24	NS	0.73
WCST Perseverative Responses	91.33	8.63	89.55	14.85	0.36	21	NS	0.15
WCST Persevertive Errors	90.00	9.47	89.82	13.82	0.04	21	NS	0.02
WCST Nonperseverative Errors	92.83	11.99	85.45	16.97	1.21	21	NS	0.51
WCST Conceptual Level Response	89.67	7.69	86.27	18.45	0.57	21	NS	0.24
TPQ Total Score	23.15	5.81	23.43	6.58	-0.11	25	NS	-0.04
TPQ Staff Perceptions	11.62	3.48	12.29	3.71	-0.48	25	NS	-0.19
TPQ Program Perceptions	11.54	3.02	11.14	3.59	0.31	25	NS	0.12

* Significant at p< 0.05

Table 4.10

Mann-Whitney U Test comparing Methadone and Second Methadone Samples, including Cohen's d

	First Methadone Sample			Second Methadone Sample			Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig.	Cohens *d*
	n	Mean	SD	n	Mean	SD					
TMT Part B Percentile	15	48.67	26.15	38.29	24.75	14	95.00	215.00	-0.12	NS	-0.16
WCST Total Number of Errors	12	90.92	7.03	86.91	16.43	11	54.50	120.50	-0.71	NS	0.32

* Significant at $p < 0.05$

DISCUSSION

Experiment 4 assessed the cognitive functioning of a second sample of individuals in MMT. Compared to the normative data, this sample obtained lower scores for all measures of the WMS-III-A with the exception of the Logical Memory II subtest, the TMT Part A and B Percentile Scores, Stroop Colour T-Score, and all measures of the WCST-A. Obtained psychometric results were not shown to differ between individuals who attended both of their last two scheduled appointments and those who had attended one of their two most recently scheduled appointments. No significant difference was shown between the two groups on the any of the TPQ scores.

While the obtained results differed slightly from those obtained for the initial Methadone sample described in *Experiment 3*, analysis showed that the two samples did not statistically differ on any of the psychometric results, or on the TPQ.

The findings from the present study are discussed below.

Wechsler Memory Scale-III-A

In the current sample, lower scores were obtained on all measures of the WMS-III-A compared to the normative mean, with the exception of the Logical Memory II subtest. While the Logical Memory II subtest score was not significantly different from the normative mean, the medium effect size for this measure suggest that with a larger sample this result may be significant. In addition, the scores obtained by this sample were more than one standard deviation below the normative mean for all memory measures with the exception of the Family Pictures subtests.

Thus, overall the results suggest that the sample had impairments in short and long-term visual memory, and in immediate, delayed and total memory ability. Analysis of individual results showed that more than half of the sample obtained scores more than one standard deviation below the normative mean on all WMS-III-A measures, with the exception of Logical Memory II. As mentioned previously, results more than one standard deviation below the normative mean are considered to indicate clinically significant impairment (Kongs, Thompson, Iverson, & Heaton, 2000; Lezak, Howieson, Loring, Hannay, & Fisher, 2004; Wechsler, 2002), and that clinically significant impairments are likely to result in a noticeable affect on

behaviour (McBurney & White, 2004). Therefore, more that half of the individuals in this sample would be expected to have noticeable difficulties in both short and long-term visual memory, as well as in short-term verbal memory. These impairments would likely result in difficulties remembering, and later recalling, information, which is likely to impact on their daily functioning. For example, individuals may have difficulty recalling appointment times, or tasks that they need to complete.

Wisconsin Cart Sorting Test-Abbreviated

Mean scores obtained on the WCST-A, while significantly different from the normative data, were within one standard deviation of the normative mean for this sample. Analysis of individual results, however, showed that half of the participants obtained scores more than one standard deviation below the normative mean on the Total Number of Errors, Nonperseverative Errors, and Conceptual Level Responses measures. These findings suggest that while the overall sample obtained results within the normative range these were lower than expected, and a large number of individuals obtained results in the impaired range. The three measures on which the participants obtained results more that one standard deviation below the normative mean are said to assess errors in problem solving, as well as difficulty identifying ways in which to solve a problem. This suggests that half of the current sample has impairments in these abilities, and that these individuals may have increased difficulty with problem solving tasks in their daily lives. For example, individuals may have difficulties coping with stressors or interpersonal conflicts, and may have difficulties achieving goals such as those set in treatment. This may mean that these individuals avoid situations that require problem solving skills, or may ask others to solve problems for them. In regards to treatment specifically, this may mean that individuals avoid appointments in which they think conflicts will arise, or do not complete therapy homework tasks.

Trail Making Test

On the TMT, mean scores obtained by this sample were lower than the normative means on both the TMT A and B, however, these scores were within one standard deviation of the normative mean. An analysis of individual results showed that while mean results were within one standard deviation of the normative mean, 5 individuals obtained results that were more than one standard deviation below the

normative mean on Part A, and 9 on Part B. These findings suggest that over one-third of the sample had impairments in simple attention, and almost two thirds had impairments in divided attention and cognitive flexibility. Therefore, these individuals are likely to have difficulty paying attention to tasks in their daily lives (Lezak et al., 2004), particularly when the task has several components, and are likely to have difficulty attending to information in treatment sessions. These difficulties, in combination with the impairments noted on the WMS-III-A suggest that individuals may have difficulty recalling information as a result of poor attention.

While a significant percentage of the sample obtained scores in the impaired range on the TMT there was no indication of consistent, global impairments on either the TMT A or TMT Part B.

Stroop Colour and Word Test

Results for this sample on the Stroop Colour and Word Test are indicative of no impairment in inhibition or impulse control, as although lower scores were obtained compared to the normative data they were within on standard deviation. While no impairments were shown in inhibition and impulse control, significantly lower scores were obtained on the Stroop Colour T-Score. This finding suggests that the current sample may have difficulty identifying colours, although a similar finding was not found in the initial methadone sample. As no previous research with methadone populations appears to have found impairments in colour naming ability, further research is needed to examine this finding.

Treatment Perceptions Questionnaire

Similar findings to those found in *Experiment 3* on the TPQ were found in this sample. The findings on the TPQ suggested dissatisfaction with the MMT programme run by CADS in Hamilton, although the obtained results on the TPQ were variable. Individual feedback on the TPQ in this sample was similar to that found for the initial methadone sample. Additionally, the current sample said that MMT was provided as the 'only option', that flexible treatment rules were needed, that high staff turnover created difficulties for clients, and that staff were not always contactable. The additional concerns raised by the Second Methadone sample may highlight changes that have occurred between collection of the two methadone samples, in particular, the number of new staff that had been employed at CADS in the intervening time

between the two studies. However, other concerns were similar across the two samples suggesting that overall service provision had not changed between the collection periods.

As with *Experiment 3*, no significant correlations were found between the TPQ scores and methadone dose or time in MMT. Unlike *Experiment 3*, however, no relation was found between scores on the TPQ and the measures used to assess adherence to treatment which may suggest that satisfaction with treatment is not related to adherence. Further research is needed to examine this finding.

Neuropsychological Performance & Treatment Adherence

In this sample, adherence to treatment was not found to relate to any of the psychometric scores or the TPQ. Large effect sizes were, however, obtained for the WMS-III-A Family Pictures II, TMT A and B, and WCST-A Total Number of Errors and Nonperseverative Responses. Interestingly, the large effect sizes suggest better performance by those individuals who had attended only one of their two most recent appointments. These large effects sizes suggest that these variables may influence treatment adherence, although not in the expected direction. The measures on which medium and large effect sizes were obtained differ from those found in *Experiment 3*. This may suggest that some aspects of cognitive functioning are inversely related to adherence to treatment, although further research is needed to assess this result fully. As mentioned in *Experiment 3*, this finding may also suggest that individuals with increased impairment are more likely to attend services to seek assistance.

Limitations

As with the initial Methadone sample obtained in *Experiment 3*, there were a number of limitations in the current study. Despite having reduced the number of psychometric measures administered in this study, and therefore the required time to administer the psychometric measures, recruitment of participants was slow with only 14 participants recruited between January 2007 and December 2007. It was hoped that this reduction in measures would increase participation in the research, however this was not successful.

As with the initial Methadone sample, individuals were recruited on a voluntary basis through the treatment service. As participation in the research was voluntary, and not a requirement of treatment, this may have limited the number of

participants for this sample. Inclusion of the Needle Exchange as a recruitment location was also unsuccessful in substantially increasing the number of participants that were recruited for this study.

Additionally, as potential participants could not be approached directly, and were instead recruited through notices and information provided by staff at CADS and the Needle Exchange Service, reliance on these methods may have affected participation recruitment adversely. In particular, changes in staff at CADS during the recruitment period may have been detrimental to recruitment for this study as was the case in *Experiment 3*.

As with *Experiment* 3, limited incentives were offered for participation in this study. It was hoped that by reducing the time needed to participate in the research, the limitations regarding reimbursement would be reduced. Given the difficulty recruiting participants for this methadone sample, this does not appear to have been the case.

As with the initial Methadone study, the current methadone sample may have only included individuals who regularly attended the service, and who may, therefore, have less significant impairments than the general methadone population (although this is difficult to determine). By including the Needle Exchange Service as a recruitment location it was hoped that individuals who were on the MMT programme but were not regularly attend the Community Alcohol and Drug Service would be recruited. However, of the 3 participants recruited through the Needle Exchange, 2 were regular attendees of the CADS MMT programme. The inclusion of this service, therefore, was not effective in achieving this aim.

In the current study, no relation was found between adherence to treatment (as measured in this study) and obtained results on the psychometric measures or the TPQ. As previous research has suggested a link between treatment adherence and cognitive functioning (e.g. Aharonovich et al., 2003; Fals-Stewart, 1993; Fals-Stewart & Lucente, 1994; Fals-Stewart & Schafer, 1992; Fals-Stewart et al., 1994; Teichner et al., 2002; Verdejo-Garcia et al., 2004), this finding is contrary to that expected. As discussed in *Experiment 3*, this may suggest that the adherence criteria used in the current study was not appropriate to measure adherence to treatment in this population. Alternatively, this adherence measure may be appropriate although participants who were non-attendees were not captured in this sample. While no other way to assess adherence could be found here, given the data available, further

research with a wider range of adherence criteria, or that includes non-attendees may show different results.

Overall Findings

The results from this study support the conclusions of *Experiment 3*, as the findings from this Second Methadone sample are comparable to those obtained previously. Overall, the findings from both samples suggest impairments in short and long-term visual and verbal memory, divided attention and cognitive flexibility, and problem solving ability. In particular, impairments in short and long-term visual memory were especially pronounced.

While the mean scores for the majority of measures were within one standard deviation of the normative mean for both samples, analysis of individual results showed that a significant number of individuals obtained scores that were one and two standard deviations below the normative mean on several of the psychometric measures. In particular, more than half of the individuals obtained results more than one standard deviation below the normative mean on the measures of short and long-term visual memory, and divided attention and cognitive flexibility. More than a third of the participants in the methadone samples also obtained results more than one standard deviation below the normative mean on the measures of short-term visual memory, overall short and long-term memory, total memory ability, and problem solving ability.

Results more than one standard deviation below the normative mean on the administered measures are said to be representative of impairment in the area that the psychometric tests assess (Kongs et al., 2000; Lezak et al., 2004; Wechsler, 2002). Therefore, the results from both methadone samples suggest that a large percentage of individuals had impairments in aspects of memory, divided attention and cognitive flexibility, and problem solving. Results more than one standard deviation below the normative mean are likely to represent clinically significant impairments in these areas. The difficulties likely to be associated with impairments in these areas are outlined below.

Story recall, as assessed by the Logical Memory subtests of the WMS-III-A, has been considered as predictive of everyday memory functioning (Sunderland, Watts, Baddeley, & Harris, 1986). As such, it is expected that individuals would have difficulty recalling information that they have heard in their everyday lives, with

memory ability in this population further impacted upon by the impairments noticed in divided attention (Lezak et al., 2004). Difficulty recalling information in a verbal format was slightly better in both methadone samples after a delay suggesting that information processing in this population may be slower. Additionally, this suggests that individuals in this population may require more time to learn new information, and to integrate this information, which may be of particular relevance to how treatment services are provided. For example, repetition of information both in, and across treatment sessions, providing information in several formats, and encouraging the use of diaries may help with impairments in memory.

Impairments in visual memory were greater than impairments in verbal memory for both methadone samples, suggesting that individuals had difficulty recalling information in a visual format. This suggests that individuals in this population will find that information presented in a verbal format is easier to recall than information presented in a visual format, although as noted above, individuals also had impairments in verbal memory. As such, a combination of both visual and verbal formats may increase recall of information in this population. This finding may also suggest that general/working memory is impaired in this population, given that recent research suggests that the Family pictures subtest of the WMS-III-A is more likely to be a measure of general/working memory (Chapin, Busch, Naugle, & Najm, 2008; Dulay, Schefft, Testa, Fargo, Privitera, & Yeh, 2002; Lezak, Howieson, Loring, Hannay, & Fisher, 2004; Lichtenberger, Kaufman, & Lai, 2001). Impairments in working memory may mean that learning of new information may be difficult for this population, and may explain ongoing maladaptive behaviour patterns reported in individuals on methadone maintenance.

Performance on the TMT suggests that less than one-third of participants in the methadone sample had impairments in simple attention, although a significant percentage had impairments in divided attention and cognitive flexibility. Impairment in simple attention may present as distractibility or difficulty focusing on the task at hand, while divided attention impairments are noticeable when tasks have several components that require manipulation at once, and the ability to process the information from these tasks simultaneously (Mitrushima, Boone, & D'Elia, 1999). These results suggest that individuals with impairments in divided attention will have difficulty paying attention to two or more tasks at once, and that information should be provided in a simplified format to allow for increased processing time. Repetition

of important information, given the impairments in memory may be useful for individuals in MMT.

No impairments in inhibition or impulse control as measured by the Stroop Colour and Word Test were identified in either sample, which suggests that this population is unlikely to have difficulty in this area. This contrasts with previous research that has suggested a link between inhibition/impulse control, and substance use (Verdejo-Garcia et al., 2004). This finding may suggest that inhibition/impulse control is not related to ongoing substance use in opioid populations, and that other factors are more relevant i.e. problem solving or working memory impairments.

Impairments on the WCST-A is indicative of impairments in concept formulation and reasoning, with individuals reported to have difficulty generalising information, forming concepts and using categories, and applying procedural rules and general principles (Lezak et al., 2004). Impairments in these aspects of functioning may result in difficulties solving problems in daily life, as well as abiding by rules both in, and out, of treatment settings. In both methadone samples, performance was within one standard deviation of the normative mean, however, at least 25% of individuals obtained results more than one standard deviation below the normative mean on the WCST-A measures which suggests impairments in these areas.

Overall, impairments in the areas of memory, attention, and problem solving have the potential to impact on the ability of this population to adhere to and remain in treatment, although in the current study treatment adherence, as measured by attendance at doctors appointments, did not relate to impairments in any of these areas. Results for both samples did, however, show large effect sizes on several psychometric measures. This may mean that there is a relation between cognitive functioning and treatment adherence which was not observed in the current studies due to the small sample sizes. More research is needed to examine these findings.

In order to further examine the findings from *Experiment 3* and *Experiment 4,* a sample of individuals who were not in MMT, but who were drug and alcohol users was recruited. The intention was to see if the cognitive deficits found for both the MMT samples were unique to individuals on MMT, or if these cognitive impairments were evident in other drug and alcohol populations. In order to recruit individuals for this sample, the Salvation Army Bridge Programme was included as a recruitment

location in addition to CADS and the Needle Exchange Service. The data for the comparison drug and alcohol samples is reported in *Experiment 5*.

EXPERIMENT 5

As discussed previously, the number of participants recruited for *Experiment 3* and *Experiment 4* was lower than expected. It was hoped that in reducing the measures administered in *Experiment 4* that the number of participants volunteering to participate in the research would increase, however, this was not the case. Further, advertising for individuals who were on MMT through the Needle Exchange Service did not increase the recruitment rate. However, the sample obtained in *Experiment 4* obtained similar results on the psychometric tests to the original methadone sample collected in *Experiment 3*.

Given the difficulties in recruiting participants for both *Experiment 3* and *Experiment 4*, a sample of individuals who were not in MMT, but who were alcohol users, drug and alcohol users, and opiate users was recruited The intention was to see if the cognitive deficits found for both of the MMT samples were unique to individuals on MMT, or were evident in other drug and alcohol populations.

Numerous research studies have suggested that individuals who use substances and or alcohol are likely to experience some type of cognitive impairment. Previously, in the *Introduction*, the impacts of cocaine, opiates and polysubstance use on cognitive functioning were discussed in relation to the existing literature on substance use. Below, further information is provided about the relationship between alcohol use and cognitive functioning.

Alcohol

Research suggests that alcohol is the most widely used substance within New Zealand (Wilkins, Casswell, Bhatta, & Pledger, 2002), with an estimated 81% of adult consuming alcohol once per week on average. In addition, an estimated 52% of individuals aged 12-17 years consume alcohol fortnightly on average (Alcohol Advisory Council of New Zealand, 2005). Estimates suggest that 635,000 adults drink at least once a week, and 785,000 adults drink regularly, often daily, with 1.2 million New Zealanders considering binge drinking to be acceptable, and regularly binge drink themselves (Alcohol Advisory Council of New Zealand, 2008). Historically, alcohol was one of the first recreational drugs, and worldwide sales are now estimated at more than $300 billion per year (Iversen, 2001).

Current estimates suggest that as many as 5-10% of individuals are dependent on alcohol (Iversen, 2001), however due to the social acceptability and legality of this substance few individuals seek treatment unless the use of alcohol impacts significantly on job, family, and life in general. Alcohol consumption within New Zealand is of particular concern, with a large percentage of alcohol consumed in binge sessions. Estimates suggest that 3.8 drinks are consumed in an average drinking session across all ethnicities, with rates increasing in Pacific Islanders (6.3) and Maori (6.9) respectively (NZPA, 2005). This is consistent with previous research in the area of alcohol use in New Zealand which suggests that 31% of men and 14% of women drink enough to feel drunk at least once a month (Adamson et al., 2000). More recently, research by the Alcohol Advisory Council of New Zealand (2005) suggests that 40% of individuals over 18 years of age binge drink on a regular basis.

While alcohol remains a socially accepted substance, the estimated social cost due to misuse is approximately 2-3% of New Zealand's Gross National product (Howden-Chapman, Bushnell, & Carter, 1994). The direct cost of alcohol use within New Zealand (i.e., hospital costs, accident compensation payments, police and justice costs) was estimated between $341 million and $589 million in 1991; and with indirect costs (i.e. loss of production, reduced work efficiency) this figure was suggested to be much higher, between $1045 million and $4005 million (Devlin, Scuffham, & Bunt, 1997). These estimates do not account for some of the more visibly obvious costs of alcohol use such as property damage or damage from minor incidents that go unreported. In addition, the costs to the immediate family such as domestic violence and impact of child rearing practices, or use of alcohol during pregnancy are not included in this estimate.

As discussed previously in *Experiment 2*, research is increasingly suggesting that use of alcohol, especially continued and longer term use, results in impairment in cognitive functioning (Clifford, 1990; Evert & Oscar-Berman, 1995; Fals-Stewart, Schafer, Lucente, Rustine, & Brown, 1994; Fein, Bachman, Fisher, & Davenport, 1990; Gruber & Yurgelun-Todd, 2001; Jones, Knutson, & Haines, 2003; McCrady & Smith, 1986; Moselhy, Georgiou, & Kahn, 2001; Oscar-Berman & Marinkovic, 2003). The causal use of alcohol has not, however, found consistent results. A discussion of the findings in regards to casual alcohol use is outlined in *Experiment 2*.

Cognitive impairment in alcohol users in general have been reported more consistently in the literature compared to substance users, and appear to be

particularly prevalent in individuals who have used alcohol at harmful levels for more that 10 years (Eckardt et al., 1998; Parsons & Nixon, 1998). For example, research by Glass, Chan and Rentz (2000) with 134 individuals in treatment for drinking under the influence (DUI) offences, found that 73% had one or more clinically significant cognitive impairments (2 standard deviations below the normative data on the measures used).

Some research, however, suggests that abstinence may result in some recovery of functioning (Munro, Saxton, & Butters, 2000), although other research suggests that while cognitive flexibility diminishes with age, cognitive impairments in alcohol dependent individuals may be more permanent (Pfefferbaum, Rosenbloom, & Sullivan, 2002). The findings with regards to alcohol use and cognitive functioning are summarised below.

Attention has often been reported as unimpaired in alcohol using samples (Beatty, Katzung, Moreland, & Nixon, 1995; Brown, Tapert, Granholm, & Delis, 2000; Kelly, Johnson, Knoller, Drubach, & Winslow, 1997; Tedstone & Coyle, 2004), however, some studies have reported impairments in attention (Duka, Townshend, Collier, & Stephens, 2003; Glass et al., 2000; Goldstein et al., 2004). Impairments in perceptual abilities have been reported less consistently, with some studies finding perceptual impairments (Beatty, Blanco, Hames, & Nixon, 1997; Beatty et al., 1995; Fama, Pfefferbaum, & Sullivan, 2004; Farquhar, Lambert, Drummond, Tiplady, & Wright, 2002; Munro et al., 2000; Sparadeo & Butters, 1983; Tivis, Beatty, Nixon, & Parsons, 1995), but not all research has agreed with this finding (Alterman & Hall, 1989; Munro et al., 2000; Nixon, Paul, & Phillips, 1998).

The majority of research studies have reported deficits in the memory abilities of alcohol using samples (Farquhar et al., 2002; Kim, Lee, Choi, & Go, 2003; Sparadeo & Butters, 1983), although some research suggests that memory abilities may improve with abstinence. Deficits have been reported in short-term memory, (Alterman, Kushner, & Holahan, 1990; Errico, King, Lovallo, & Parsons, 2002; Flannery et al., 2007; Nixon et al., 1998; Selby & Azrin, 1998; Tivis et al., 1995), long-term memory, (Alterman et al., 1990; Brown et al., 2000; Errico et al., 2002; Selby & Azrin, 1998), working memory (Ambrose, Bowden, & Whelan, 2001; Fishbein et al., 2007; Flannery et al., 2007), and spatial memory (Beatty et al., 1997; Townshend & Duka, 2005). Deficits have also been reported in both visual memory (Brown et al., 2000; Errico et al., 2002; Fishbein et al., 2007; Glass et al., 2000;

Goldstein et al., 2004; Williams & Skinner, 1990), and verbal memory (Beatty et al., 1995; Errico et al., 2002; Tarquini & Masullo, 1981; Tivis et al., 1995; Uekermann, Daum, Schlebusch, Wiebel, & Trenckmann, 2003).

While the majority of studies have reported deficits in memory, some studies have not agreed with these findings (Beatty et al., 1997; Beatty et al., 1995; Brown et al., 2000; Errico et al., 2002; Tarquini & Masullo, 1981; Uekermann et al., 2003), with particularly inconsistent results reported in abstinent alcohol users who have been reported as both impaired (Dawson & Grant, 2000; Fama et al., 2004; Munro et al., 2000; Zinn, Stein, & Swartzwelder, 2004) and not impaired (Dawson & Grant, 2000; Munro et al., 2000; Zinn et al., 2004) on different memory tests.

The findings regarding the verbal functioning of alcohol users have been inconsistent, with some studies reporting impairments (Glass et al., 2000; Tivis et al., 1995; Williams & Skinner, 1990) and others reporting no impairments (Chaney, O'Leary, Fehrenbach, & Donovan, 1980; Tarquini & Masullo, 1981; Uekermann et al., 2003; Zinn et al., 2004). Likewise, with regards to learning ability, some studies report no impairment (Brown et al., 2000; Kim et al., 2003; Munro et al., 2000), while others have reported impairments (Brown et al., 2000; Munro et al., 2000).

Cognitive flexibility and executive functioning have often been measured in alcohol samples. Impairments have been reported on the WCST (Beatty et al., 1995; Errico et al., 2002; Fama et al., 2004; Goldstein et al., 2004; Williams & Skinner, 1990), with most studies reporting perseverative behaviour in this population (Lezak, Howieson, Loring, Hannay, & Fisher, 2004). Impairments have also been found in impulse control and inhibition (Fishbein et al., 2007; Flannery et al., 2007; Selby & Azrin, 1998; Tedstone & Coyle, 2004; Townshend & Duka, 2005; Uekermann et al., 2003), although these have not been reported by all studies (Duka et al., 2003; Fishbein et al., 2007). Impairments in cognitive flexibility, as measured on the TMT, have been reported by some studies (Alterman et al., 1990; Goldstein et al., 2004; Selby & Azrin, 1998; Zinn et al., 2004), with others reporting no impairment (Munro et al., 2000). Impairments in problem solving and abstract reasoning have been reported by several studies (Beatty et al., 1995; Brown et al., 2000; Dawson & Grant, 2000; Fishbein et al., 2007; Glass et al., 2000; Sparadeo & Butters, 1983; Tedstone & Coyle, 2004; Uekermann et al., 2003; Williams & Skinner, 1990; Zinn et al., 2004). Other studies have reported no impairments (Beatty et al., 1995; Brown et al., 2000; Flannery et al., 2007; Williams & Skinner, 1990).

Some studies suggest impairment in psychomotor speed (Beatty et al., 1995; Duka et al., 2003; Farquhar et al., 2002; Fishbein et al., 2007; Flannery et al., 2007; Selby & Azrin, 1998; Tivis et al., 1995; Zinn et al., 2004), while other studies do not (Brown et al., 2000; Kim et al., 2003; Nixon et al., 1998; Selby & Azrin, 1998; Tivis, Tivis, & Nixon, 1999; Tivis et al., 1995).

In summary, the findings regarding the effects of alcohol on cognitive functioning are not consistent. For some cognitive abilities there is equal evidence both for and against an effect of alcohol use. For other abilities, the majority of studies do suggest that excessive alcohol use/abuse results in impairments. Overall these studies suggest that alcohol users are likely to experience impairments in memory, as well as executive functioning tasks such as problem solving and abstract reasoning, although some studies have contested these findings. As with studies involving users of other substances, observations of alcohol using populations in treatment, have linked these cognitive impairments with poor treatment adherence and retention to treatment (Blume, Schmalinga, & Marlatt, 2005; Cooney, Kadden, Litt, & Getter, 1991; Fals-Stewart et al., 1994; McCrady & Smith, 1986; Rychtarik et al., 2000; Tapert, Senses Ozyurt, Myers, & Brown, 2004).

As outlined in the *Introduction* the inconsistent results reported for alcohol populations on cognitive measures may be a result of a number of factors. For example, frequency, amount, and length of alcohol use may affect the obtained results, as may the different measures used to assess these cognitive functions. Demographic factors such as previous head injuries, overdoses, or psychiatric comorbdity may also affect results. Research does, however, suggest that alcohol populations have increased rates of cognitive impairments that are not seen in the general population.

As outlined above, *Experiment 5* reports on the results of the drug and alcohol samples that were recruited parallel to *Experiment 4*. This study was conducted to see if the cognitive deficits found for the methadone samples in *Experiment 3* and *Experiment 4* were unique to individuals on MMT, or if these deficits are associated with general alcohol and substance use. In order to compare the samples, the same measures that were administered in *Experiment 4* were administered in the current study. In spite of the lack of findings in *Experiment 3* and *Experiment 4* regarding

adherence, it was decided to continue to measure this in *Experiment 5* to allow for comparison across the samples.

In comparing the literature available for this different sample groups with the research on individuals in MMT, the suggested impairments in the cognitive functioning of alcohol users are most consistently reported. Findings for both alcohol and methadone samples suggest that impairments in memory, and aspects of cognitive flexibility are likely, although findings also suggest that impairments in attention are likely in individuals on MMT. As such, it would be expected that impairments in alcohol samples may be more likely, as results have been more consistent with this population, although results across the two populations should be similar.

Findings for polysubstance populations have been less consistent, with no consistent results reported to date. Findings do, however, suggest that polysubstance users may show greater levels of cognitive impairment compared to other substance populations. Research with opiate users, predominantly those using heroin, have also been inconsistent, although the impairments reported are similar to those listed for the methadone population.

Given the findings to date, it would be expected that the methadone sample obtains similar cognitive functioning results as other drug and alcohol samples, although greater impairment may be seen in polysubstance users. The differences between samples from these populations are examined further in this study.

METHOD

Participants

A total of 30 individuals recruited from the Community Alcohol and Drug Service, Salvation Army Bridge Program, and Needle Exchange Service in Hamilton were interviewed, from 36 individuals who initially agreed to be contacted. The remaining individuals either declined to be interviewed when they were contacted, did not arrive for an arranged interview, or were unable to be contacted. Of the 30 individuals that were interviewed, one was excluded due to acute cannabis intoxication leaving a sample of 29 individuals.

This sample was then divided according to the type of treatment each participant was receiving. The final samples were: Alcohol (n=13); Other Drug and Alcohol (excluding opiate use) (n=11); and Other Opiates (not in MMT programme) (n=5). Further details on these samples are available in the *Results* section.

Materials

The psychometric measures administered to each participant in this study were identical to those administered in *Experiment 4*. A description of these measures is available in the sections titled *Experiment 1* and *Experiment 3*.

Procedure

Prior to the commencement of this research, ethical approval was obtained from the Psychology Department Human Research Ethics Committee at the University of Waikato and the Northern Y Regional Ethics Committee (part of the Health and Disability Ethics Committee).

Participants were recruited from CADS, Salvation Army Bridge Programme, and the Needle Exchange Service, all of which were located in Hamilton. Participants from CADS were recruited between January 2005 and December 2007, while individuals from the Salvation Army Bridge Programme and Needle Exchange Service were recruited between January 2007 and December 2007. Individuals recruited through the Community Alcohol & Drug Service and the Salvation Army Bridge Programme were in treatment programmes for alcohol and/or drug use that were provided by these services. Individuals recruited through the Needle Exchange were either in treatment at a service within Hamilton, were not in treatment but using substances, or had been substance users previously. Participants were recruited via information fliers posted at CADS (see Appendix XV), Salvation Army (see Appendix XVI), and the Needle Exchange (see Appendix XVII), and through information provided by staff to consumers of these services.

Individuals were eligible to participate in the research if they currently or previously used alcohol and/or drugs at the time of the assessment, and were over the age of 18 years. Individuals were excluded from the research if the staff at the service deemed them to be intoxicated (either alcohol or substance induced) at the time of the interview, and/or they had a current major mental illness (judged on a case by case basis).

All individuals who used the treatment services provided by the Community Alcohol and Drug Service and Salvation Army Bridge programme were given the opportunity to participate in the research, and provided that they met the stability criteria they were invited to take part in the research. As with previous studies, exclusion criteria were kept to a minimum to allow for a truer representation of this population and to allow for the extraction of meaningful results that will be useful for the entire population. Exclusion due to intoxication or substance impairment was assessed on the day of the interview, as research suggests that intoxicated individuals may not comprehend fully what they are agreeing to participate in (McCrady & Bux Jr., 1999).

Individuals who agreed to take part in the research, were provided with the information sheet about the research (see Appendices XVII, XIX, and XX), and once they had completed the necessary consent forms (see Appendices XXI, XXII, and XXIII), they were administered the neuropsychological tests, and asked a short series of questions regarding recent substance/alcohol use, and previous head injuries (see Appendix XXIV). The neuropsychological tests were the same as those administered in *Experiment 4*, and were administered in the same order. The TPQ was included as part of this study and was administered at the end of the test sequence. All interviews were conducted on a one on one basis in a room at CADS, Salvation Army Bridge programme, or Needle Exchange Service. Following the completion of the assessment, individual participation was recorded for the individuals from CADS in their files (see Appendix XIV).

Individuals were required to consent to a review of their file in order to assess their adherence to treatment, and to gain further demographic information. Participants were provided with refreshments and tea/coffee for participation in the research, as it was considered to be inappropriate to give them a financial incentive.

Adherence Measures

As mentioned in *Experiment 3*, many different measures have been used to assess adherence to treatment. For the purposes of this study, adherence was assessed as outlined below:

- Number of missed keyworker appointments – based on the two most recently scheduled appointments. An individual was considered to have missed/not

attended a scheduled appointment if they failed to attend the initial scheduled appointment or the replacement appointment if one was scheduled within two weeks of the original appointment. The percentage of attended appointments was based on the last two initial appointments scheduled (if individuals attended the replacement appointment they were considered to have completed the criteria of having attended the scheduled appointment). This approach was used by Gutierrez, Ballesteros, Gonzalez-Oliveros, & Ruiz de Apodaka (1995) who used unjustified absence from 5 consecutive or 10 alternative follow-up appointments as evidence of non-adherence with treatment.

Demographic Information

Demographic information was obtained from the short demographic questionnaire completed by participants, and through file reviews (e.g. previous drug use, DSM diagnoses etc) as this information was collected for all individuals on initial assessment at the CADS and at the Salvation Army Bridge programme.

Scoring and data entry

Scoring and data entry was conducted as outlined in *Experiment 3*. Participants from the CADS and the Salvation Army Bridge programme were given the option of receiving feedback on the results of the testing, and, if participants agreed, this information was included in their case notes at the respective service also. Individuals from the Needle Exchange Service were not provided with feedback on their individual results.

Analysis was conducted using SPSS Version 12, and was based on the same psychometric scores as outlined in *Experiment 3*. The results from the TPQ were analysed in the same manner as in *Experiment 3*.

RESULTS

This study was conducted to assess the occurrence of cognitive impairments in individuals who reported a history of alcohol, drug and alcohol, or opiate use. The samples collected were: an Alcohol sample (n=13); a Drug and Alcohol sample (excluding opiate use) (n=11); and an Other Opiates Sample (n=5). All participants were recruited through the CADS, the Needle Exchange Service, and the Salvation Army Bridge Program in Hamilton, New Zealand.

As shown in Table 5.1, the Alcohol sample had a mean age of 45.23 years, and were predominantly of New Zealand European descent. There were a similar numbers of males and females in the sample, and on average the sample had completed the equivalent of 6th Form or Year 12/NCEA Level 2. The Alcohol sample had been in this episode of treatment for a mean of 5 ½ months, and four of the individuals had received treatment for alcohol and/or drug concerns previously, with a mean number of treatment episodes of 1.17. Of the sample, 8 had used other substances previously, but none of the Alcohol sample reported current use of other substances.

The Drug and Alcohol sample had a mean age of 33.00 years and were predominantly of New Zealand European descent. There were a greater number of males than females in the sample, and on average the sample had completed the equivalent of 5th Form or Year 11/NCEA Level 1. The Drug and Alcohol sample had been in this episode of treatment for a mean of 8 months, and three of the individuals had received treatment for alcohol and/or drug concerns previously, with a mean number of treatment episodes of 0.82.

The Other Opiate sample consisted of three individuals in treatment who used opiates other than methadone, and two individuals who had used opiates previously but were not in treatment at the time of assessment. The Other Opiate sample had a mean age of 39.00 years, were predominantly of New Zealand European descent and had completed the equivalent of Form 7 or Year 13/NCEA Level 3.

The results for each of the samples are reported separately in the following section, and are followed by between group comparisons.

Table 5.1

Demographic details of Alcohol, Drug & Alcohol, and Other Opiate Samples

	Alcohol		Drug & Alcohol		Other Opiate	
Age	45.23	SD 10.47, Range 25-59	33.00	SD 5.78, Range 21-44	39	SD 8.156, Range 32-53
Gender						
Male	6	46.2%	7	63.6%	3	60%
Female	7	53.8%	4	36.4%	2	40%
Handedness						
Left	4	30.80%	3	27.3%	0	
Right	9	69.20%	8	72.7%	5	100%
Education	12.15 years	SD 2.34, Range 9-17	11.09 years	SD 1.14, Range 10-14	13.40 years	SD 2.70, Range 10-16
Ethnicity						
NZ European/Pakeha	8	61.5%	8	72.7%	4	80%
Maori	2	15.4%	3	27.3%	0	
Maori/European	2	15.4%	0		0	
Other European	1	7.7%	0		1	20%
Program History						
Time in Program	8 months	SD 5.5 months Range 1 month-1.5 years	8.3 months	SD 1.2 months Range 1 month - 3 years	-	-
Previous Treatment	1.17	SD 2.86, Range 0-10	0.82	SD 1.66, Range 0-5	-	-
Substance History						
First Drug Use	22 years	SD 11.80, Range 13-49	14.64 years	SD 2.69, Range 9-19	14 years	SD 2.16, Range 12-17
First Opiate Use	-	-	-	-	19.5 years	SD 1.91, Range 18-22

Alcohol Sample

As discussed previously, the Alcohol sample consisted of 13 individuals recruited from the Community Alcohol and Drug Service. One participant was excluded from the analysis of the Stroop due to colour-blindness, while the same participant and one other participant did not complete the WCST-A.

Prior to any analysis, Shapiro-Wilks tests were conducted on the data to assess for normality. Results from this analysis suggested that the data for the WMS-III-A Family Pictures I ($W = 0.850$, df = 13) and Trail Making B Percentile Score ($W = 0.811$, df = 13) were significantly different from the normal distribution. Subsequently, transformations were conducted on these measures, and square-root transformations normalised the distribution of scores for the WMS-III-A Family Pictures I subtest. The data from the TMT Part B were unable to be normalised. As such, the results for the TMT Part B should be interpreted with caution.

A series of one sample t-tests was conducted to compare the scores of these participants with the normative data provided in the administration manuals for each test, with the exception of the Trail Making Test. The Trail Making Test data were compared to the normative data provided by Tombaugh (2004) as discussed in *Experiment 1*.

The one sample t-tests showed significant differences between the obtained and the normative data for a number of measures. A summary of these results is presented in Table 5.2. Significantly lower scores were found compared to the normative sample on the WMS-III-A Family Pictures I and II subtests and Immediate Memory score, and Stroop Colour T-Score. Medium effect sizes were obtained on all measures of the WMS-III-A with the exception of the Logical Memory I and II subtests, and the Stroop Colour T-Score. Results from the Alcohol sample on all other measures were not significantly different from the normative sample at $p < 0.05$.

A comparison of the obtained results to the normative standard deviation ranges provided for each measure showed that, while the Alcohol sample differed significantly from the normative data on a number of measures, the mean scores for all measures fell within one standard deviation of the test norm for the majority of measures. This indicates that the results on these measures were not clinically significant. A summary of the mean and standard deviation scores for each measure are provided in Table 5.3.

TABLE 5.2

One sample t-test comparing Alcohol Sample to Normative Data, including means, standard deviations and Cohen's d

	Normative		Alcohol					Cohens
	Mean	SD	Mean	SD	t	df	Significance	*d*
WMS Logical Memory I	10	3	8.69	3.43	-1.38	12	NS	-0.44
WMS Family Pictures I	10	3	7.77	3.11	-2.58	12	*	-0.74
WMS Logical Memory II	10	3	8.92	3.55	-1.09	12	NS	-0.36
WMS Family Pictures II	10	3	8.08	3.15	-2.20	12	*	-0.64
WMS Immediate Memory	100	15	89.38	16.39	-2.34	12	*	-0.71
WMS Delayed Memory	100	15	92.38	16.51	-1.66	12	NS	-0.51
WMS Total Memory	100	15	89.85	16.93	-2.16	12	NS	-0.68
TMT Part A Percentile	50	16th	47.46	31.87	-0.29	12	NS	-0.07
TMT Part B Percentile	50	16th	45.46	33.49	-0.49	12	NS	-0.13
Stroop Word T-Score	50	10	49.50	7.67	-0.23	11	NS	-0.05
Stroop Colour T-Score	50	10	42.42	6.23	-4.22	11	*	-0.76
Stroop Colour-Word T-Score	50	10	51.75	6.45	0.94	11	NS	0.18
Stroop Interference T-Score	50	10	49.92	6.86	-0.04	11	NS	-0.01
WCST Total Number of Errors	100	15	96.73	12.03	-0.90	10	NS	-0.22
WCST Perservation Responses	100	15	96.27	11.88	-1.04	10	NS	-0.25
WCST Perservation Errors	100	15	95.55	10.70	-1.38	10	NS	-0.30
WCST Nonperservation Errors	100	15	95.09	8.18	-1.99	10	NS	-0.33
WCST Conceptual Level Responses	100	15	97.45	11.52	-0.73	10	NS	-0.17

* Significant at $p < 0.05$

TABLE 5.3

Means and Standard Deviations of Normative Data and Alcohol, Drug and Alcohol, and Other Opiate Samples

	Normative Mean	One Standard Deviation	Alcohol Mean	Alcohol SD	Drug & Alcoho	Drug & Alcohol SD	Other Opiate Mean	Other Opiate SD
WMS Logical Memory I	10	3	8.69	3.43	6.82	4.45	6.40	3.21
WMS Family Pictures I	10	3	7.77	3.11	6.82	2.99	6.40	1.95
WMS Logical Memory II	10	3	8.92	3.55	7.09	3.94	7.60	3.13
WMS Family Pictures II	10	3	8.08	3.15	7.09	3.18	6.60	2.41
WMS Immediate Memory	100	15	89.38	16.39	81.18	19.47	78.80	11.63
WMS Delayed Memory	100	15	92.38	16.51	84.55	17.59	85.00	13.49
WMS Total Memory	100	15	89.85	16.93	81.64	19.02	81.20	12.46
TMT Part A Percentile	50th	16th	47.46	31.87	48.55	29.92	53.50	29.59
TMT Part B Percentile	50th	16th	45.46	33.49	34.73	27.92	24.00	21.91
Stroop Word T-Score	50	10	49.50	7.67	48.36	12.82	44.50	7.59
Stroop Colour T-Score	50	10	42.42	6.23	44.55	15.52	42.00	7.35
Stroop Colour-Word T-Score	50	10	51.75	6.45	53.36	12.01	49.75	8.54
Stroop Interference T-Score	50	10	49.92	6.86	52.55	5.59	52.25	5.85
WCST Total Number of Errors	100	15	96.73	12.03	83.10	15.67	74.50	7.55
WCST Perservation Responses	100	15	96.27	11.88	91.20	9.45	83.75	7.27
WCST Perservation Errors	100	15	95.55	10.70	89.60	9.90	81.75	8.02
WCST Nonperservation Errors	100	15	95.09	8.18	84.70	14.70	78.25	8.54
WCST Conceptual Level Responses	100	15	97.45	11.52	86.50	13.98	72.75	3.30

* TMT results are presented in percentile scores. One standard deviation below the 50th percentile is the 16th percentile

The data from the Alcohol sample were examined for each participant to assess the clinical level of impairment (i.e. one and two standard deviations below the normative mean). Outlined in Table 5.4 is the number of individuals who were impaired on each of the measures at either one or two standard deviations from the normative mean. The exception to this is the TMT where only one standard deviation (16^{th} Percentile) was used. Participants are numbered according to the order in which they were recruited.

This analysis showed that 2 participants obtained scores more than two standard deviations below the normative mean on most measures of the WMS-III-A. These 2 participants, as well as another 2 participants, obtained scores one standard deviation below the normative means on both the TMT Part A and Part B.

Relation between demographic and psychometric test results

As for previous experiments, the relation between psychometric results and gender, handedness, years of education, head injuries and overdoses were assessed. Table 5.5 shows that years of education was positively correlated with the WMS-III-A Family Pictures II subtest, Immediate Memory and Total Memory measures. Number of overdoses was positively correlated with WCST-A Perseverative Errors. Gender, handedness and number of head injuries were not correlated with any of the measures.

Other Drug Use

Of the 13 individuals in the Alcohol sample, 11 participants reported no use of other substances in the last 48 hours. The remaining 2 participants reported use of benzodiazepines. As only two participants reported using other substances, no formal analysis was conducted comparing the results of these two groups. Comparison of the means, as shown in Table 5.6, showed that the benzodiazepine group obtained poorer results on the WMS-III-A Delayed Memory and Total Memory scores, TMT part B Percentile Score, and Stroop Colour T-Score, and higher scores on all measures of the WCST-A with the exception of the Nonperseverative Errors measure.

Table 5.4

Number of Individuals obtaining scores One and Two Standard Deviations below norm in Alcohol, Drug and Alcohol, and Other Opiate Samples

	Alcohol			Drug and Alcohol			Other Opiate		
	n	1 SD	2 SD	n	1 SD	2 SD	n	1 SD	2 SD
WMS Logical Memory I	13	3	2 [1,3]	11	2	4 [2,3,4,10]	5	0	2 [3,4]
WMS Family Pictures I	13	2	3 [1,6,7]	11	4	2 [3,10]	5	3	0
WMS Logical Memory II	13	2	2 [1,7]	11	2	3 [2,3,10]	5	1	1 [3]
WMS Family Pictures II	13	4	2 [1,7]	11	3	3 [2,3,10]	5	3	0
WMS Immediate Memory	13	3	2 [1,7]	11	1	4 [2,3,4,10]	5	3	1 [3]
WMS Delayed Memory	13	3	2 [1,7]	11	2	3 [2,3,10]	5	2	1 [3]
WMS Total Memory	13	3	2 [1,7]	11	1	4 [2,3,4,10]	5	3	1 [3]
TMT Part A Percentile	13	4 [1,5,7,11]		11	2 [3,4]		4	1 [3]	
TMT Part B Percentile	13	4 [1,5,7,11]		11	5 [2,3,4,5,10]		5	3 [2,3,5]	
Stroop Word T-Score	12	2	0	11	0	2 [3,4]	4	1	0
Stroop Colour T-Score	12	4	1 [3]	11	1	2 [3,4]	4	1	0
Stroop Colour-Word T-Score	12	0	0	11	1	2 [3,4]	4	1	0
Stroop Interference T-Score	12	1	0	11	0	0	4	0	0
WCST Total Number of Errors	11	3	0	10	4	2 [8,10]	4	2	2 [1,3]
WCST Perservation Responses	11	1	0	10	1	0	4	2	0
WCST Perservation Errors	11	2	0	10	1	1 [8]	4	2	1 [1]
WCST Nonperservation Errors	11	2	0	10	4	1 [10]	4	3	0
WCST Conceptual Level Responses	11	2	0	10	4	1 [10]	4	3	1 [1]

Alcohol Sample: Numbers correspond to participant number
Drug & Alcohol Sample: Numbers correspond to participant number
Other Opiate Sample: Numbers correspond to participant number

Table 5.5

Correlations between demographic and psychometric test results in the Alcohol Sample

	Correlation Coeffient (r)				
	Point Biserial	Point Biserial	Pearsons		
	Gender	Handedness	Years of Education	Head Injury	Overdose
WMS Logical Memory I	-0.087		0.485	0.212	-0.059
WMS Family Pictures I	0.187		0.406	-0.316	-0.245
WMS Logical Memory II	-0.111		0.534	0.239	-0.228
WMS Family Pictures II	0.228		**0.598***	-0.361	-0.169
WMS Immediate Memory	0.062		0.513	-0.059	-0.171
WMS Delayed Memory	0.071		**0.635***	-0.129	-0.242
WMS Total Memory	0.077		**.590***	-0.102	-0.226
TMT Part A Percentile	-0.278	0.344	0.129	-0.024	-0.382
TMT Part B Percentile	-0.068	-0.035	0.238	-0.113	-0.194
Stroop Word T-Score	-0.012			0.174	-0.030
Stroop Colour T-Score	-0.224			-0.110	-0.393
Stroop Colour-Word T-Score	-0.198			0.000	-0.062
Stroop Interference T-Score	-0.062			0.125	0.108
WCST Total Number of Errors	0.122			0.091	0.460
WCST Perservation Responses	-0.139			0.336	0.581
WCST Perservation Errors	0.013			0.413	**.698***
WCST Nonperservation Errors	0.432			-0.190	0.247
WCST Conceptual Level Responses	0.005			-0.055	0.452

* Significant Correlation at p< 0.05

Table 5.6

Means and standard deviations of scores obtained by the 'no other drug use' and 'benzodiazepine use' groups in the Alcohol Sample

	No Other Use			Benzodiapeine Use		
	n	Mean	SD	n	Mean	SD
WMS Logical Memory I	11	8.82	3.28	2	8.00	5.66
WMS Family Pictures I	11	7.73	3.29	2	8.00	2.83
WMS Logical Memory II	11	9.00	3.55	2	8.50	4.95
WMS Family Pictures II	11	8.27	3.38	2	7.00	1.41
WMS Immediate Memory	11	89.55	17.78	2	88.50	7.78
WMS Delayed Memory	11	93.36	17.76	2	87.00	7.07
WMS Total Memory	11	90.45	18.31	2	86.50	7.78
TMT Part A Percentile	11	47.45	34.47	2	47.50	17.68
TMT Part B Percentile	11	50.27	34.12	2	19.00	12.73
Stroop Word T-Score	10	49.10	8.41	2	51.50	0.71
Stroop Colour T-Score	10	44.00	5.12	2	34.50	6.36
Stroop Colour-Word T-Score	10	52.20	7.00	2	49.50	2.12
Stroop Interference T-Score	10	49.50	7.49	2	52.00	1.41
WCST Total No Errors	10	95.90	12.34	1	105.00	
WCST Perseverative Responses	10	94.70	11.25	1	112.00	
WCST Persevertive Errors	10	93.80	9.48	1	113.00	
WCST Nonperseverative Errors	10	95.20	8.61	1	94.00	
WCST Conceptual Level Response	10	97.00	12.04	1	102.00	

Satisfaction with Treatment

Scores on the TPQ for the Alcohol sample showed high levels of satisfaction with treatment (31.67, SD 5.91, range 21-40), and, in general, provided praise for the staff and service provision on the personal opinion section. The few exceptions to this included one participant who felt that scripts were not processed quickly enough, and another who felt that comorbid psychiatric disorders were not addressed as adequately as they could be by the treatment services.

An analysis of the individual TPQ questions indicated mean scores above 3 (indicating greater treatment satisfaction) on all but two questions: 'I have not liked all of the treatment sessions I have attended (2.58, SD 1.34) and 'I have not had enough time to sort out my problems' (2.50, SD 1.00). Analysis using the two factors identified by Marsden et al (2000) found slightly higher mean scores on the staff perceptions factor (16.42, SD 2.61) versus the program perceptions factor (15.42, SD 3.48).

Pearson Correlations were conducted to assess the relation between time in treatment and treatment satisfaction as measured by the TPQ. No significant correlations were found between time in treatment and the TPQ Score (r = -0.392), TPQ Staff Perceptions (r = -0.356), or TPQ Program Perceptions (r = -0.394).

Neuropsychological Performance & Treatment Adherence

Adherence to treatment in the Alcohol sample was measured by attendance at scheduled keyworker appointments, and individuals were deemed to have complied if they had attended their two most recent keyworker appointments. Within the Alcohol sample, 11 participants had attended their two most recent appointments while the remaining 2 had attended one of the two most recent appointments.

To assess the difference between the means of the two groups (those who attended two appointments versus those who attended one appointment) on the psychometric results, a series of Mann-Whitney U tests was conducted. The results of the WCST-A and the TPQ were not included in the analysis as the 2 participants that had attended one of their last two appointments did not complete this measure. The Stroop was also excluded as only 1 of the 2 participants had completed this measure.

As shown in Table 5.7, the 2 participants who had attended one of the two most recent appointments obtained significantly poorer scores on the WMS-III-A Logical Memory I and II subtest. Large effect sizes were obtained on all measures of

the WMS-III-A with the exception of the Family Pictures I and II subtests, and on the TMT Part B Percentile Score. The two groups did not differ on any of the other psychometric measures.

Comparison of the results for the 1 participant who did complete the Stroop compared to the rest of the sample showed that this participant obtained a lower Stroop Colour T-Score, but comparable scores on the other Stroop measures.

Table 5.7

Mann-Whitney U test comparing attendence at doctors appointments in the Alcohol Sample, including means, standard deviations and Cohen's d

	One appointment			Two appointments			ann-Whitney	Wilcoxon W	Z	Asymp. Sig.	Cohens *d*
	n	Mean	SD	n	Mean	SD					
WMS Logical Memory I	2	3.00	1.41	11	9.73	2.49	0.00	3.00	-2.18	*	-3.62
WMS Family Picture I	2	7.00	4.24	11	7.91	3.11	10.00	13.00	-0.20	NS	-0.37
WMS Logical Memory II	2	3.50	2.12	11	9.91	2.77	1.00	4.00	-1.99	*	-3.06
WMS Family Pictures II	2	6.00	2.83	11	8.45	3.17	5.50	8.50	-1.09	NS	-1.02
WMS Immediate Memory	2	70.50	17.68	11	92.82	14.38	3.00	6.00	-1.59	NS	-1.97
WMS Delayed Memory	2	72.50	13.44	11	96.00	14.68	2.00	5.00	-1.78	NS	-2.10
WMS Total Memory	2	69.00	16.97	11	93.64	14.58	3.00	6.00	-1.58	NS	-2.16
TMT Part A Percentile	2	35.00	35.36	11	49.73	32.52	7.00	10.00	-0.79	NS	-0.58
TMT Part B Percentile	2	10.00	0.00	11	51.91	32.38	2.00	5.00	-1.80	NS	-4.29

* Significant at p< 0.05

Drug and Alcohol Sample

As mentioned earlier, the Drug and Alcohol sample consisted of 11 individuals recruited from the Community Alcohol & Drug Service and the Salvation Army Bridge Program. The participants completed all of the measures with the exception of one participant who did not complete the WCST-A as they found the test 'too difficult'. This participant completed all of the remaining assessments.

Prior to any analysis, Shapiro-Wilkes tests were conducted on the data to assess for normality. Results from this analysis suggested that the data for the TMT Part B Percentile Score ($W = 0.809$, df = 11, $p < 0.05$) were significantly different from the normal distribution. Subsequently, transformations were conducted on this measure however the data were unable to normalised. As there are no non-parametric equivalents to the one sample t-test this data were compared to the normative data using the standard one sample t-test. As such the results for the TMT Part B should be interpreted with caution.

A series of one sample t-tests was conducted to compare the results obtained with the normative data provided in the administration manuals for each test, with the exception of the TMT. The TMT data were compared to the normative data provided by Tombaugh (2004) as discussed in *Experiment 1*.

The one sample t-tests showed significant differences between the obtained and the normative data for a number of measures. A summary of these results is presented in Table 5.8. The Drug and Alcohol sample obtained significantly lower scores compared to the normative sample on all measures of the WMS-III-A, and all measure of the WCST-A. Medium effect sizes were obtained on the TMT Part B Percentile Score, and WCST-A Perseverative Responses and Perseverative Errors, while large effect sizes were obtained on all measures of the WMS-III-A, and all other measures of the WCST-A. Results from the Drug and Alcohol sample on all other measures were not significantly different from the normative sample.

A comparison of the obtained results to the normative standard deviation ranges provided for each measure showed that, while the Drug and Alcohol sample differed significantly from the normative data on a number of measures, the mean scores for most of the measures fell within one standard deviation of the normative mean. The scores for all measures of the WMS-III-A, with the exception of Logical Memory II and Family Pictures II, and the WCST-A Total Number of Errors and Nonperseverative Errors, fell more that one standard deviation below the normative

mean. A summary of the mean and standard deviation scores for each measure are provided in Table 5.3.

The Drug and Alcohol sample data were examined on a case by case basis to assess overall impairment at one and two standard deviations below the normative mean. Outlined in Table 5.4 is the number of individuals who obtained scores either one or two standard deviations below the normative mean on each measure. Obtained scores on the TMT are compared at ones standard deviation (16^{th} Percentile) only. Individual participants were numbered according to the order in which they were recruited for this sample.

This analysis showed that 2 participants obtained scores that fell more than two standard deviations below the normative mean on all of the WMS-III-A measures, while an additional 2 participants obtained results more than two standard deviations below the normative data on several of the WMS-III-A measures. Two of the 11 participants obtained scores one standard deviation below the normative mean on both the TMT Part A and Part B, and an additional 3 participants obtained scores that fell more than one standard deviation below the normative mean on the TMT Part B. Participants 3 and 4 obtained results in the impaired range (more than one standard deviation below the normative mean) on all psychometric tests.

Relation between demographic and psychometric test results

As with previous samples, Pearson Correlations were calculated for the psychometric measures and years of education, handedness, gender, head injuries and overdoses. Table 5.9 shows that gender was positively correlated with the WMS-III-A Logical Memory II subtest (females obtained greater scores). Academic achievement, handedness, number of head injuries, and number of overdoses were not correlated with any of the psychometric measures.

Satisfaction with Treatment

The TPQ results for the Drug and Alcohol sample showed high levels of satisfaction with treatment (31.82, SD 4.916, range 25-39) and generally praised the staff and service provision. The exceptions to this were 1 participant who thought that the methadone maintenance treatment program and the drug and alcohol treatment service should be provided as separate services, and another who said that appointments were often cancelled by staff members.

An analysis of the individual TPQ scores indicated mean scores above 3 (indicating greater treatment satisfaction) on all questions with the exception of: ‘The staff have not always understood the kind of help I wanted’ (2.91, SD 0.944), ‘The staff and I have had different ideas about what my treatment objectives should be’ (2.45, SD 1.37), and ‘I have not had enough time to sort out my problems’ (2.45, SD 1.29). Analysis using the two factors identified by Marsden et al. (2000) found similar mean scores on bother the staff perceptions factor (16.09, SD 1.81) and the program perceptions factor (15.73, SD 3.55).

Pearson Correlations were calculated to assess the relation between time in treatment and treatment satisfaction as measured by the TPQ. No significant correlations were found between time in treatment and the TPQ Score (*r* 0.071), TPQ Staff Perceptions (*r* 0.312), or TPQ Program Perceptions (*r* -0.061).

Neuropsychological Performance & Treatment Adherence

Adherence to treatment in the Drug and Alcohol sample was measured by attendance as scheduled keyworker appointments, and individuals were deemed to have complied if they had attended their two most recent appointments. Within the Drug and Alcohol sample, 10 of the 11 participants had attended their two most recent appointments, while the remaining participant had attended one of the two most recent appointments.

As only 1 participant did not attend 100% of their appointments, analysis was not conducted for the Drug and Alcohol sample to assess the relation between neuropsychological performance and treatment adherence. Examination of the data did suggest, however, that this participant did not obtain scores that were noticeably lower than the remainder of the sample.

TABLE 5.8

One sample t-test comparing Drug and Alcohol Sample to Normative Data, including means, standard deviations and Cohen's d

	Normative		Drug and Alcohol					Cohens
	Mean	SD	Mean	SD	t	df	Significance	*d*
WMS Logical Memory I	10	3	6.82	4.45	-2.37	10	*	-1.06
WMS Family Pictures I	10	3	6.82	2.99	-3.52	10	*	-1.06
WMS Logical Memory II	10	3	7.09	3.94	-2.45	10	*	-0.97
WMS Family Pictures II	10	3	7.09	3.18	-3.04	10	*	-0.97
WMS Immediate Memory	100	15	81.18	19.47	-3.21	10	*	-1.25
WMS Delayed Memory	100	15	84.55	17.59	-2.91	10	*	-1.03
WMS Total Memory	100	15	81.64	19.02	-3.20	10	*	-1.22
TMT Part A Percentile	50	16th	48.55	29.92	-0.16	10	NS	-0.04
TMT Part B Percentile	50	16th	34.73	27.92	-1.81	10	NS	-0.45
Stroop Word T-Score	50	10	48.36	12.82	-0.42	10	NS	-0.16
Stroop Colour T-Score	50	10	44.55	15.52	-1.17	10	NS	-0.55
Stroop Colour-Word T-Score	50	10	53.36	12.01	0.93	10	NS	0.34
Stroop Interference T-Score	50	10	52.55	5.59	1.51	10	NS	0.25
WCST Total Number of Errors	100	15	83.10	15.67	-3.41	9	*	-1.13
WCST Perservation Responses	100	15	91.20	9.45	-2.94	9	*	-0.59
WCST Perservation Errors	100	15	89.60	9.90	-3.32	9	*	-0.69
WCST Nonperservation Errors	100	15	84.70	14.70	-3.29	9	*	-1.02
WCST Conceptual Level Responses	100	15	86.50	13.98	-3.05	9	*	-0.90

* Significant at p< 0.05

Table 5.9

Correlations between demographic and psychometric test results in the Drug and Alcohol Sample

	Correlation Coeffient (r)				
	Point Biserial	Point Biserial	Pearsons		
	Gender	Handedness	Years of Education	Head Injury	Overdose
WMS Logical Memory I	0.434		0.340	-0.391	0.083
WMS Family Pictures I	-0.018		0.388	-0.382	0.144
WMS Logical Memory II	**0.636***		0.333	-0.169	0.146
WMS Family Pictures II	0.164		0.302	-0.179	0.141
WMS Immediate Memory	0.308		0.379	-0.369	0.131
WMS Delayed Memory	0.460		0.368	-0.205	0.157
WMS Total Memory	0.359		0.381	-0.297	0.135
TMT Part A Percentile	0.118	0.353	0.107	-0.501	-0.319
TMT Part B Percentile	0.533	-0.277	0.118	-0.305	0.365
Stroop Word T-Score	-0.363			-0.502	-0.023
Stroop Colour T-Score	-0.168			-0.558	0.194
Stroop Colour-Word T-Score	-0.107			-0.560	0.107
Stroop Interference T-Score	0.100			-0.467	-0.005
WCST Total Number of Errors	-0.225			-0.095	0.456
WCST Perservation Responses	-0.526			-0.200	0.548
WCST Perservation Errors	-0.533			-0.079	0.556
WCST Nonperservation Errors	-0.017			0.144	0.328
WCST Conceptual Level Responses	0.156			0.039	0.476

* Significant Correlation at p< 0.05

Other Opiate Sample

As mentioned earlier, the Other Opiate sample consisted of 5 individuals recruited from the Community Alcohol & Drug Service, Salvation Army Bridge Program, and Needle Exchange Service. This sample did not complete the Treatment Perceptions Questionnaire as not all of the sample were in treatment at the time of the assessment.

Prior to any analysis, Shapiro-Wilks tests were conducted on the data to assess for normality. Results from these analyses showed that the data for the Family Pictures I subtest from the WMS-III-A ($W = 0.753$, df = 5, $p < 0.05$) and the TMT Part B Percentile Score ($W = 0.754$, df = 5, $p < 0.05$) were significantly different from the normal distribution. Subsequently, transformations were conducted on these measures, however, these transformations did not succeed in normalising these data. As there are no non-parametric equivalents to the one sample t-test, the data were compared using the standard one sample t-test. As such the results for the Family Pictures I subtest and the TMT Part B Percentile Score should be interpreted with caution.

A series of one sample t-tests was conducted to compare the results obtained with the normative data provided in the administration manuals for each test, with the exception of the Trail Making Test. The Trail Making Test data were compared to the normative data provided by Tombaugh (2004) as discussed in *Experiment 1*.

The one sample t-tests showed significant differences between the obtained and the normative data for a number of measures. A summary of these results is presented in Table 5.10. The Other Opiate sample obtained significantly lower scores compared to the normative sample on the Family Pictures I and II subtests, and Immediate and Total Memory scores of the WMS-III-A, and all measures of the WCST-A. Medium effect sizes was obtained on the WMS-III-A Logical Memory II subtest and TMT Part B Percentile Score, while large effect sizes were obtained on all other measures of the WMS-III-A, the Stroop Colour T-Score and all measures of the WCST-A. Results from the Other Opiate sample on all other measures were not statistically different from the normative sample.

A comparison of the obtained results to the normative standard deviation ranges provided for each measure showed that, while the Other Opiate sample differed significantly from the normative data on a number of measures, the mean scores fell within one standard deviation of the test norm for the majority of measures.

Obtained scores on all the measures of the WMS-III-A, with the exception of Family Picture I, and all measures of the WCST-A, fell more than one standard deviations below the normative means. The mean and standard deviation scores for each psychometric test are provided in Table 5.3.

The Other Opiate sample data were examined on a case by case basis to assess overall impairment at one and two standard deviations below the normative mean. Outlined in Table 5.4 is the number of individuals who were impaired on each of the measures at either one or two standard deviations below the normative mean. Obtained scores for the TMT are only assessed at one standard deviation (16^{th} Percentile). Participants are numbered according to the order in which they were recruited for this sample.

This analysis showed that 1 participant obtained scores more than two standard deviations below the normative mean on all measures, with the exception of the WMS-III-A Family Pictures I and II subtests and all measures of the Stroop. The remaining participants obtained scores more than one standard deviation below the normative mean on most measures with the exception of the TMT Part A Percentile Score. Participant 4 obtained impaired results on all psychometric tests (this participant did not complete the Stroop).

Relation between demographic and psychometric test results

As with previous samples, the relation between psychometric results and gender, handedness, years of education, head injuries and overdoses was assessed. Table 5.11 shows that gender was positively correlated with the WMS-III-A Family Picture I and II subtest (females obtained greater scores). Years of education was positively correlated with the WMS-III-A Logical Memory I and II subtests and Delayed and Total Scores. Number of overdoses was positively correlated with the TMT Part B Score (as number of overdoses increases, the obtained score on TMT Part B improved). Number of head injuries was not found to correlate with any of the psychometric measures.

TABLE 5.10

One sample t-test comparing Other Opiate Sample to Normative Data, including means, standard deviations, and Cohen's d

	Normative		Other Opiate		t	df	Significance	Cohens *d*
	Mean	SD	Mean	SD				
WMS Logical Memory I	10	3	6.40	3.21	-2.51	4	NS	-1.20
WMS Family Pictures I	10	3	6.40	1.95	-4.13	4	*	-1.20
WMS Logical Memory II	10	3	7.60	3.13	-1.71	4	NS	-0.80
WMS Family Pictures II	10	3	6.60	2.41	-3.16	4	*	-1.13
WMS Immediate Memory	100	15	78.80	11.63	-4.08	4	*	-1.41
WMS Delayed Memory	100	15	85.00	13.49	-2.49	4	NS	-1.00
WMS Total Memory	100	15	81.20	12.46	-3.37	4	*	-1.25
TMT Part A Percentile	50	16th	53.50	29.59	0.24	3	NS	0.10
TMT Part B Percentile	50	16th	24.00	21.91	-2.65	4	NS	-0.76
Stroop Word T-Score	50	10	44.50	7.59	-1.45	3	NS	-0.55
Stroop Colour T-Score	50	10	42.00	7.35	-2.18	3	NS	-0.80
Stroop Colour-Word T-Score	50	10	49.75	8.54	-0.06	3	NS	-0.03
Stroop Interference T-Score	50	10	52.25	5.85	0.77	3	NS	0.23
WCST Total Number of Errors	100	15	74.50	7.55	-6.76	3	*	-1.70
WCST Perservation Responses	100	15	83.75	7.27	-4.47	3	*	-1.08
WCST Perservation Errors	100	15	81.75	8.02	-4.55	3	*	-1.22
WCST Nonperservation Errors	100	15	78.25	8.54	-5.09	3	*	-1.45
WCST Conceptual Level Responses	100	15	72.75	3.30	-16.49	3	*	-1.82

* Significant at p< 0.05

Table 5.11

Correlations between demographic and psychometric test results in the Other Opiate Sample

	Correlation Coeffient (r)			
	Point Biserial	Pearsons		
	Gender	Years of Education	Head Injury	Overdose
WMS Logical Memory I	0.028	**0.928***	-0.452	-0.424
WMS Family Pictures I	**0.983***	-0.038	-0.068	-0.191
WMS Logical Memory II	0.262	**0.910***	-0.274	-0.301
WMS Family Pictures II	**0.910***	0.223	-0.014	-0.118
WMS Immediate Memory	0.487	0.751	-0.363	-0.404
WMS Delayed Memory	0.609	**0.686***	-0.171	-0.244
WMS Total Memory	0.572	**0.703***	-0.243	-0.301
TMT Part A Percentile	0.146	0.496	0.282	0.211
TMT Part B Percentile	-0.167	0.135	0.843	**0.881***
Stroop Word T-Score	-0.304	-0.525	0.836	0.809
Stroop Colour T-Score	-0.393	-0.286	0.314	0.259
Stroop Colour-Word T-Score	0.169	-0.858	0.845	0.761
Stroop Interference T-Score	0.543	-0.880	0.839	0.774
WCST Total Number of Errors	0.044	0.540	-0.603	-0.727
WCST Perservation Responses	0.298	-0.031	-0.619	-0.770
WCST Perservation Errors	0.270	-0.254	0.355	-0.774
WCST Nonperservation Errors	-0.410	0.915	-0.540	-0.559
WCST Conceptual Level Responses	0.050	0.240	-0.757	-0.876

* Significant Correlation at $p < 0.05$

Neuropsychological Performance across samples

The three samples (Alcohol, Drug and Alcohol, and Other Opiate) were compared to one another to identify any patterns in impairments across the different substances. Additionally, the three samples were compared to the Combined Methadone sample, which consisted of those participants recruited in *Experiments 3* and *Experiment 4*.

A series of one-way ANOVAs assessed the difference between the samples with regards to age and years of education, while a chi squared test for independence was used to assess the difference between the samples with regards to gender and ethnicity.

As shown in Table 5.12, age was significantly different between at least two of the samples, while years of education did not significantly differ across the groups. Post-hoc analysis showed that age in the Alcohol sample differed from the Drug and Alcohol and Combined Methadone samples. As shown in Table 5.13, the results for the chi squared test for independence showed gender and ethnicity were not related to sample membership.

A series of one-way ANOVAs and Kruskal Wallis tests were conducted to assess the difference between the samples. Kruskal Wallis tests were conducted when one or more of the samples differed significantly from the normative distribution. As shown in Table 5.12 and Table 5.14, statistically significant differences between at least two of the groups were obtained on the WCST-A Total Number of Errors and Conceptual Level Responses. Post-hoc analysis showed that the Other Opiate sample obtained significantly lower scores on both of these measures compared to the Alcohol sample. No other significant differences were found between the four samples.

In addition to comparing the obtained scores on the neuropsychological measures, a series of one-way ANOVAs were conducted to assess the difference between the Alcohol, Drug and Alcohol, and Combined Methadone samples on the TPQ. The Other Opiate sample was not included in this analysis as they did not complete the TPQ. As shown in Table 5.15, obtained scores on all of the TPQ measures differed significantly between at least two of the samples. Post-hoc analysis showed that the Combined Methadone sample obtained significantly lower mean scores on the Treatment Perceptions Questionnaire Total, Staff Perceptions and Program Perceptions scores compared to the Alcohol, and Drug and Alcohol samples.

TABLE 5.12

One-Way ANOVA comparing the Alcohol, Drug and Alcohol, Other Opiate, and Combined Methadone Samples on psychometric test results, including means, standard deviations and R^2

	Alcohol			Drug & Alcohol			Other Opiate			Combined Methadone			df	df	F obt.	Sig.	R^2
	n	Mean	SD	n	Mean	SD	n	Mean	SD	n	Mean	SD	between	within			
Age	13	45.23	10.47	11	33.00	5.78	5	39.00	8.16	29	36.48	6.16	3	54	6.21	*	0.26
Years of Education	13	12.15	2.34	11	11.09	1.14	5	13.40	2.70	29	11.97	2.87	3	54	1.02	NS	0.05
WMS Logical Memory I	13	8.69	3.43	11	6.82	4.45	5	6.40	3.21	29	8.31	3.15	3	54	1.01	NS	0.05
WMS Logical Memory II	13	8.92	3.55	11	7.09	3.94	5	7.60	3.13	27	8.52	3.14	3	52	0.71	NS	0.04
WMS Family Pictures II	13	8.08	3.15	11	7.09	3.18	5	6.60	2.41	27	6.70	3.05	3	52	0.64	NS	0.03
WMS Immediate Memory	13	89.38	16.39	11	81.18	19.47	5	78.80	11.63	29	86.17	14.75	3	54	0.84	NS	0.04
WMS Delayed Memory	13	92.38	16.51	11	84.55	17.59	5	85.00	13.49	27	87.52	14.91	3	52	0.58	NS	0.03
WMS Total Memory	13	89.85	16.93	11	81.64	19.02	5	81.20	12.46	27	85.63	15.31	3	52	0.63	NS	0.03
TMT Part A Percentile	13	47.46	31.87	11	48.55	29.92	4	53.50	29.59	29	43.66	25.58	3	53	0.20	NS	0.01
Stroop Word T-Score	12	49.50	7.67	11	48.36	12.82	4	44.50	7.59	26	46.42	10.81	3	49	0.37	NS	0.02
Stroop Colour T-Score	12	42.42	6.23	11	44.55	15.52	4	42.00	7.35	26	43.38	8.16	3	49	0.12	NS	0.01
Stroop Colour-Word T-Score	12	51.75	6.45	11	53.36	12.01	4	49.75	8.54	26	51.15	11.89	3	49	0.15	NS	0.01
Stroop Interference T-Score	12	49.92	6.86	11	52.55	5.59	4	52.25	5.85	26	52.00	8.93	3	49	0.28	NS	0.02
WCST Total Number of Errors	11	96.73	12.03	10	83.10	15.67	4	74.50	7.55	23	89.00	12.31	3	44	3.74	*	0.20
WCST Perservation Responses	11	96.27	11.88	10	91.20	9.45	4	83.75	7.27	23	90.48	11.76	3	44	1.40	NS	0.09
WCST Perservation Errors	11	95.55	10.70	10	89.60	9.90	4	81.75	8.02	23	89.91	11.47	3	44	1.73	NS	0.11
WCST Nonperservation Errors	11	95.09	8.18	10	84.70	14.70	4	78.25	8.54	23	89.30	14.73	3	44	2.03	NS	0.12
WCST Conceptual Level Responses	11	97.45	11.52	10	86.50	13.98	4	72.75	3.30	23	88.04	13.68	3	44	3.89	*	0.21

* Singficant at $p < 0.05$

Table 5.13

Chi-Squared tests comparing demographic characteristics of Alcohol, Drug and Alcohol, Other Opiate, and Combined Methadone Samples

	X^2	Asymp. Sig
Alcohol & Drug and Alcohol Samples		
Gender	0.743	NS
Ethnicity	3.055	NS
Alcohol & Other Opiate Samples		
Gender	0.277	NS
Ethnicity	2.215	NS
Alcohol & Combine Methadone Sample		
Gender	0.563	NS
Ethnicity	1.682	NS
Drug and Alcohol & Other Opiate Sample		
Gender	0.019	NS
Ethnicity	3.588	NS
Drug and Alcohol & Combine Methadone Sample		
Gender	0.084	NS
Ethnicity	4.556	NS
Other Opiate & Combined Methadone Sample		
Gender	0.003	NS
Ethnicity	1.037	NS

* Significant at $p < 0.05$

Table 5.14

Kruskal Wallis Test comparing the Alcohol, Drug and Alcohol, Other Opiate and Combined Methadone Samples on psychometric test results, including means, and standard deviations

	Alcohol			Drug and Alcohol			Other Opiate			Combined Methadone			Chi-Square	df	Assump Sig
	n	Mean	SD	n	Mean	SD	n	Mean	SD	n	Mean	SD			
WMS Family Pictures I	13	7.77	3.11	11	6.82	2.99	5	6.40	1.95	29	7.00	2.46	1.50	3	NS
TMT Part B Percentile	13	45.46	33.49	11	34.73	27.92	5	24.00	21.91	28	23.39	23.00	4.23	3	NS

TABLE 5.15

One-Way ANOVA comparing Alcohol, Drug and Alcohol, and Combined Methadone Samples on the TPQ, including means, standard deviations and R^2

	Alcohol			Drug & Alcohol			Combined Methadone			df	df	F obt.	Sig.	R^2
	n	Mean	SD	n	Mean	SD	n	Mean	SD	between	within			
TPQ Total Score	12	31.67	5.91	11	31.82	4.92	27	23.30	6.11	2	47	13.04	*	0.36
TPQ Staff Perceptions	12	15.42	3.48	11	15.73	3.55	27	11.33	3.27	2	47	12.43	*	0.35
TPQ Program Perceptions	12	16.42	2.61	11	16.09	1.81	27	11.96	3.55	2	47	9.76	*	0.29

* Singficant at $p < 0.05$

DISCUSSION

Experiment 5 was conducted to assess the cognitive functioning of individuals who were not in MMT, but who had a history of alcohol and drug use. The intention was to see if the cognitive deficits found for in the MMT samples described in *Experiment 3* and *Experiment 4* were unique to individuals on MMT, or were evident in other drug and alcohol populations. In addition, this study aimed to assess the cognitive functioning of drug and alcohol populations in New Zealand compared to overseas research findings.

Several samples were recruited for this study, and these included 13 individuals in treatment for alcohol use, 11 individuals in treatment for drug and alcohol use, and 5 individuals who were past or present opiate users (not in methadone maintenance). The findings for each of the respective samples are outlined in the following section.

Wechsler Memory Scale-III-Abbreviated

All three samples in the current study obtained lower scores than the normative data on the WMS-III-A, with lower scores reported most often on the Family Pictures I and II subtests, and on the Immediate Memory score. In addition, individual analysis showed that approximately half of the individuals in the Alcohol, and Drug and Alcohol samples obtained results in the impaired range (more than one standard deviation below the normative mean), and 3 of the 5 individuals in the Other Opiate sample obtained results in the impaired range on the Family Pictures I and II subtests.

These results suggest that the portion of the sample with scores more than one standard deviation below the normative mean are likely to have difficulty with both short and long-term visual and verbal/working memory. Impairment in these areas is likely to impact upon their ability to recall information in their everyday lives, as well as remembering and later recalling information in treatment settings. Results from the Alcohol sample support this relation, as poorer scores on the WMS-III-A Logical Memory I and II subtest, as well as on the TMT Part B Percentile Score were associated with poorer adherence.

In interpreting findings from these samples, it should be noted that scores on the WMS-III-A were found to correlate with years of education in the Alcohol and Other Opiate samples. Previous research has reported similar findings in regards to the WMS and academic achievement (Stanton, Savageau, Aucion, Jenkins, & Zyzanski, 1984). This finding may suggest that memory ability may be improved through training, and training may improve adherence and retention in these populations. Alternatively, this finding may also suggest that those with better memory skill are more likely to achieve higher educational qualifications.

A comparison of the results obtained for the three samples in this study, with those obtained for the Combined Methadone sample found no differences in the scores obtained on the WMS-III-A. Examination of mean scores for the samples showed lower mean scores for both the Drug and Alcohol and Other Opiate samples on the WMS-III-A compared to the Alcohol sample and the Methadone sample (with the exception of the delayed memory measures for the Methadone sample). The Methadone sample also obtained lower mean scores on the delayed memory measures compared to the Alcohol sample. These results suggest that memory deficits are more prevalent in drug and alcohol and other opiate samples, and the individuals in methadone maintenance have particular difficulty with delayed memory.

Wisconsin Card Sorting Test-Abbreviated

Mean scores for the Alcohol sample on the WCST-A were comparable to the normative means, and most individuals obtained scores that fell within the normative range on each of the given measures. These results contrast with the literature that has reported impairments on the WCST in alcohol populations (Beatty et al., 1995; Errico et al., 2002; Fama et al., 2004; Goldstein et al., 2004; Williams & Skinner, 1990). These results suggest that the current Alcohol sample did not experience significant impairment in problem solving and abstract thinking. Therefore, the participants in this Alcohol sample are unlikely to have difficulty solving problems, or thinking about material in an abstract way (Kongs, Thompson, Iverson, & Heaton, 2000; Lezak et al., 2004).

The disparity between the current findings and those found in previous research may be attributable to differences in the populations being studies. For example, studies have examined different frequency of use, amount consumed, and history of use, as well as individuals during and following detoxification from alcohol

(Beatty et al., 1995; Errico et al., 2002; Fama et al., 2004; Goldstein et al., 2004; Williams & Skinner, 1990). These factors were not assessed in the current sample so it if difficult to identify the reason for the obtained results.

Both the Drug and Alcohol, and Other Opiate samples obtained lower scores on the WCST-A compared to the normative data. The Drug and Alcohol sample obtained mean scores that fell more than one standard deviation below the normative mean on the Total Number of Errors and Nonperseverative Errors, while the Other Opiate sample obtained scores that fell more than one standard deviation below the normative mean on all WCST-A measures. The results for the Drug and Alcohol sample suggest some impairment in problem solving and abstract reasoning, with 50% of the sample obtained impaired results on aspects of this test. Additionally, the results suggest that several participants had difficulties with working memory and understanding sorting principles, however, no perseveration was evident across the sample. Impairments in these areas are likely to result in difficulties solving problems in daily life, which may also affect successful progress in treatment (Lezak et al., 2004).

Individual results for the Other Opiate sample showed that 3 of the 4 participants who completed the WCST-A obtained results in the impaired range on Number of Categories Completed, and all 4 participants obtained results in the impaired range on Conceptual Level Reponses. These results suggest that the sample lacked understanding of the sorting principles in the WCST-A, and had difficulties identifying solutions in problem solving. Results in the impaired range (more than one standard deviation below the normative mean) were also noted on the Perseverative Responses and Perseverative Errors measures, with 2 and 3 individuals obtaining scores in the impaired ranges of these measures respectively. This suggests that the Other Opiate sample did not use the feedback given on incorrect responses to modify their behaviour. As with the Drug and Alcohol sample, impairments in these areas are likely to negatively impact on daily functioning.

Comparison of the three samples showed that the greatest scores on the WCST-A were obtained by the Alcohol, with a large difference in scores between the Alcohol and Other Opiate samples. Interestingly, the Alcohol sample was also the oldest of the sample suggesting that problem solving ability may improve with age or practice over time. Comparisons between the other samples showed no significant findings on the measures of the WCST-A. This suggests that the greatest impairment

in problem solving ability is seen in other opiate users, followed by drug and alcohol users, with alcohol users showing the least impairment.

The difference in scores obtained by the samples, while not statistically significant for all measures of the WCST-A, suggests that problem solving ability may be more impaired in some drug and alcohol populations. Interestingly, the methadone and other opiate sample obtained mean scores that differed by a large degree on the Total Number of Errors and Conceptual Level Responses measures. Given that individuals on MMT are previous illicit opiate users, this finding may suggest that while illicit opiate use impairs functioning, both in current and previous users, methadone may improve problem solving ability in individuals currently in an MMT programme. However, as identified in *Experiment 3*, long term methadone maintenance also appears to be associated with a possible impairment in problem solving ability. Future research may wish to examine these findings.

Trail Making Test

In the current study, mean results for all three samples were within one standard deviation of the normative mean for the TMT. These findings suggest that the three samples were not impaired in attention or cognitive flexibility. Individual results did, however, show that a number of participants in each sample obtained results more than one standard deviation below the normative mean on the TMT Part A and Part B. Four participants in the Alcohol sample obtained results in this range on both the TMT Part A and Part B; 1 participant on the TMT Part A and 5 participants on the TMT Part B in the Drug and Alcohol sample; and 3 participants on the TMT Part B in the Other Opiate sample.

The findings the TMT Part A for these individuals suggests they are likely to have difficult with simple attention, while results more than one standard deviation below the normative mean on the TMT Part B suggest impairments in divided attention and cognitive flexibility. Impairments in these areas are likely to have an effect on their ability to participate in treatment, and to function effectively in their daily lives. Additionally, difficulties in attention are likely to be related to the impairments in memory that were reported in all of the samples (Lezak et al., 2004).

The findings on the TMT for the Other Opiate sample should be interpreted with particular caution, as a positive correlation was found between overdoses and the TMT Part B score. This suggests that as the number of overdoses increases, greater

(better) scores are obtained on TMT Part B. This finding is surprising given that the TMT is considered to be a measure of organic brain damage (Reitan, 1986; Tombaugh, 2004).

The three samples in the current study obtained similar results to the methadone samples in *Experiments 3* and *4*. Less than one-third of the participants in the Combined Methadone sample had impairments in simple attention, while over 60% had impairments in divide attention and cognitive flexibility. The findings suggest that attentional impairments are not specific to individuals in MMT, with impairments on the TMT Part B observed most often. As discussed in *Experiment 4*, individuals with impairments in divided attention are more likely to have difficulty paying attention to several tasks at once, and it is recommended that information is provided in a simplified format.

Stroop Colour & Word Test

Results for the three samples were comparable to the normative means on all measures of the Stroop, with the exception of the Alcohol sample which obtained a lower mean Stroop Colour T-Score. Previously, research in cocaine users has suggested that impairments in colour naming may be a result of colour vision impairment in acute withdrawal (Kelley, Yeager, Pepper, & Beversdorf, 2005). However, it seems unlikely that this would account for the results of the Alcohol sample as none of the individuals reported symptoms of withdrawal, or were going through a withdrawal process at the time of assessment. Golden and Freshwater (2002) have also suggested that impairment in colour naming may be a result of impairments in the temporal-occipital region of the right hemisphere, although research has not assessed this link thoroughly.

Overall, results on the Stroop for all three samples suggest the participants do not have difficulty with impulse control or inhibition. As such, it would be expected that individuals in the three samples are able to control their impulsivity, and that rule violations and other acts often attributed to impulsivity would be lower in this sample. These findings contrast with previous research that suggests impairments in inhibition and impulse control may account for continued alcohol and substance use (Verdejo-Garcia et al., 2004).

The findings for the three samples in this study on the Stroop are similar to those reported in the methadone samples in *Experiment 3* and *4*. Overall, the results for all samples suggest no impairments in inhibition or impulse control.

Treatment Perceptions Questionnaire

The TPQ was administered to the Alcohol and Drug and Alcohol samples in the current study. On this measure, both samples reported high levels of treatment satisfaction, and participants in both samples provided praise for the staff and service provision.

Compared to the Combined Methadone sample, both of the samples in this study obtained significantly higher scores on the TPQ (indicating greater treatment satisfaction). This suggests that treatment dissatisfaction is associated specifically with aspects of the MMT program, rather than the general service provision provided by CADS and the Salvation Army Bridge Programme. The lower levels of treatment satisfaction in the methadone samples is comparable to the literature in this area (Deering et al., 2003; National Treatment Agency for Substance Misuse, 2007; Simpson, Joe, & Brown, 1997; Strang et al., 2000; Villafranca, McKellar, Trafton, & Humphreys, 2005). This suggests that while the methadone samples were less satisfied with the CADS treatment service in Hamilton, this low level of satisfaction is associated with MMT programmes in general.

Neuropsychological Performance & Treatment Adherence

Previous research has suggested a link between cognitive impairment in alcohol dependent sample and poor treatment adherence (Blume et al., 2005; Cooney et al., 1991; Fals-Stewart et al., 1994; Kadden, Cooney, Getter, & Litt, 1989; McCrady & Smith, 1986; Rychtarik et al., 2000; Tapert et al., 2004). In the current study, only the treatment adherence of the Alcohol sample was assessed formally. Poorer treatment adherence in the Alcohol sample was associated with impairments on the WMS-III-A Logical Memory I and II subtests, and the TMT Part B Percentile Score. The relationship found between treatment adherence and the WMS-III-A Logical Memory I and Logical Memory II scores is similar to that reported by Blume et al (2005) who found an association between verbal and delayed memory scores on the WMS-R and motivation in treatment.

The findings for the Alcohol sample suggest that poorer treatment adherence is associated with impairments in verbal memory. However, caution should be taken in interpreting this result as this was a small sample, and only 2 participants did not attend 100% of their scheduled appointments. The greater attendance rates seen in the Alcohol sample in the current study corresponds with the literature which has shown that individuals in treatment for alcohol have higher levels of adherence (Veach, Remley, Kippers, & Sorg, 2000).

The relation between cognitive impairment and treatment adherence in the Drug and Alcohol sample was not formally assessed, as 10 of the 11 participants had attended 100% of their two most recent appointments. While no formal analysis was conducted, comparison of the data showed that the one participant who had missed an appointment did not obtain scores that were noticeably lower than the remainder of the sample. This finding suggests that cognitive impairments, as measured in this study are not associated with attendance at keyworker appointments in the drug and alcohol population.

The findings for the Alcohol sample in the current study contrast with those reported in *Experiment 3* and *Experiment 4*. The results from *Experiment 3* suggested that poorer treatment adherence was associated with lower levels of treatment satisfaction. This differs from the results found for both methadone samples, where there was an association between poorer treatment adherence and better psychometric test scores. However, it should be noted that the measures associated with poorer adherence, while similar, differed across the two methadone samples.

Limitations

In this study, participants were recruited form CADS, the Salvation Army Bridge Programme, and the Needle Exchange Service in Hamilton. Participation in the research was available to all individuals who were attending these services provided they met the inclusion/exclusion criteria. Individuals from the Community Alcohol and Drug Service were recruited between January 2005 and December 2007, while the individuals from the Salvation Army Bridge Program and Needle Exchange were recruited between January 2007 and December 2007. All participants were recruited through information fliers posted at CADS, and through information provided by staff to consumers of these services. While the research was available to almost all individuals in these services, only 36 individuals agreed to be contacted. Of

this 36, 30 completed the research, however, one was excluded from the research due to acute cannabis intoxication. As such, the three samples are relatively small, and for several reasons may not be representative of the population as a whole.

Firstly, individuals were recruited on a voluntary basis so would only include those individuals who visited the services, or who heard about the research from other individuals. Secondly, while 36 individuals agreed to be contacted with regards to participation in the research, only those individuals who arrived for the appointments could be interviewed. As discussed in *Experiments 3* and 4, comparison with individuals who did not arrive for their appointments, and a comparison with the greater populations would have helped to determine whether the samples were a true representation of the populations being studies. As such, the obtained Alcohol and Drug and Alcohol samples in this study may only include individuals who attend treatment services regularly, and this may be indicative of less severe impairment (although this is difficult to determine). The Needle Exchange was included as a recruitment location in this study in the aim of recruiting individuals who did not attend their appointments at the treatment services, however, none of the participants in the Alcohol or Drug and Alcohol samples were recruited through this service.

Another limitation of the current study was the limitations surrounding the use of incentives in attracting participants. Previous research with drug and alcohol populations has suggested that financial incentives could be considered as coercion to participate as financial incentives could be used to aid continued drug seeking behaviour (Cunningham, 1998; Galanter & Kleber, 1999; McCrady & Bux Jr., 1999). Despite this, the majority of drug and alcohol research studies provide incentives for participation. Being unable to offer any incentives may have decreased the likelihood that these individuals would be willing to participate in research.

One final limitation was the difficultly in identifying adherence to treatment. As mentioned in the previous studies, due to the limitations of the information that is collected routinely by CADS, adherence was measured by attendance at appointments. Therefore, the adherence criteria used in this study may not be a true representation of adherence at these treatment services. A link between cognitive impairment and treatment adherence may exist, but may not have been found in this study due to limitations with the adherence measure.

Strengths

While there were a number of limitations in the current study, there were also a number of strengths. The current study assessed the cognitive functioning of several different drug and alcohol populations in New Zealand in addition to the methadone samples obtained in earlier studies. Little research has been conducted in New Zealand previously that has assesses the cognitive functioning of drug and alcohol populations, despite evidence that different rates and types of substance use occur in New Zealand compared to other countries. Therefore, this research provides information about the cognitive impairments of drug and alcohol users in the New Zealand populations.

As mentioned previously, individuals were not excluded from the current unless they were deemed to be intoxicated, or were considered to be mentally unstable at the time of assessment. Only one individual was excluded based on these criteria, as they were acutely intoxicated at the time of assessment. The minimum exclusion criteria used in this study, and in the previous methadone samples, allowed for a truer representation of the population being sampled, while also controlling for confounding variables such as head injuries and overdoses. As research suggests that such variables are common in drug and alcohol populations, the exclusion of individuals with these confounding variables would have reduced the applicability of the current findings to the larger drug and alcohol population in New Zealand.

The current research also included psychometric measures that have been well validated in overseas populations. In addition, *Experiment 1* which was conducted to assess the utility of the psychometrics in New Zealand, found that the normative data for these psychometric measures is applicable within the New Zealand setting. Previous research has, at times, used measures that have not been well validated, or have not been normed on a representative sample. As such, the psychometric measures used in the current research are an improvement on some studies that have been reported previously. However, as noted earlier, the small samples sizes do limit the application of the findings.

Overall Findings

In the current study, the cognitive functioning of alcohol users, drug and alcohol users, and other opiate users were assessed. These results were additionally

compared to the results obtained by the methadone samples in order to assess whether the impairments found in *Experiments 3* and *4* were specific to individuals in MMT, or were related to general alcohol and substance use.

Overall, the findings suggest that all individuals who use alcohol and drugs, including those in MMT, have difficulty recalling information in a visual format, and recalling information in the short-term. Impairments in these areas may have some impact on attendance at appointments, as the association between the WMS-III-A Logical Memory I and II subtest and adherence in the Alcohol sample suggests.

No consistent impairments were reported in the attentional abilities of any of the samples, including the methadone samples, however, an analysis of individual results showed that a larger number of participants obtained results in the impaired range on the TMT Part B Percentile Score. This finding suggests greater difficulty with tasks requiring divided attention, and cognitive flexibility which may impact on the ability to attend to information in daily life as well as in treatment sessions. In addition, scores on the TMT Part B were found to be associated with poorer adherence in the Alcohol sample suggesting that divided attention may play a role in attendance at appointments.

One of the most unexpected findings was that all of the samples obtained results on the Stroop that were comparable to the normative data. This suggests that participants did not have difficulty with controlling impulses, which would suggests that these samples would have lower rates of continued substance use or reported violent or threatening behaviour. These behaviours may, however, be associated with other factors (such as dependence) which may reduce impulse control ability.

Obtained results on the WCST-A were inconsistent, with poorer performance found for the Drug and Alcohol, Other Opiate, and Methadone samples, but not the Alcohol sample. Individual results showed that all samples had participants that obtained results in the impaired range. Overall, these findings suggest that drug and alcohol use, and opiate use (both methadone and other opiates) is associated with greater impairments in problem solving ability. In particular, individuals appear to make more errors in problem solving, and have difficulty identifying the correct solution to a problem. Impairments on the WCST-A are likely to be associated with difficulties in daily life, and also in implementing treatment strategies, however, the current study did not find an association between impairment on their measures and attendance at appointments.

As mentioned previously, greater treatment satisfaction was found in the Alcohol and Drug and Alcohol samples compared to the Combined Methadone sample. This finding suggests that treatment dissatisfaction is associated specifically with aspects of the MMT program (i.e. prescription of methadone), rather than the general service provision provided by these services. This may suggest a need to revise aspects of the MMT programme at CADS, although it is noted that national guidelines and regulations limit the changes that can be made. Specifically, issues such as the inconsistency with which rules are applied, and how decisions are made about a clients treatment need to be addressed.

Recommendations

Based on the findings from these studies, a number of recommendations can be made. Firstly, given that a large number of the individuals in these studies obtained lower scores on the measures of memory and problem solving, changes to treatment services that accommodate these deficits may be beneficial. For example, providing treatment information in several formats, and repetition of this information across sessions may promote retention. Reminders regarding appointments may also increase adherence in these populations, although it is noted that adherence in the Alcohol and Drug and Alcohol sample were better than that seen in the Combined Methadone sample. Additionally, skills could be taught in regards to problem solving, and working through everyday issues in treatment sessions may promote the use of these skills outside of treatment.

Further research is also needed to assess the cognitive functioning of these populations. While the current study consisted of small samples, the findings do suggest impairments in these populations. Further research may be able to elaborate on the findings of this research, and examine the link between cognitive impairments and adherence to treatment further.

GENERAL DISCUSSION

The aim of this research was to explore the cognitive deficits of several different drug and alcohol samples in New Zealand, and to assess the association between cognitive outcomes and adherence to treatment. Specifically, the research included individuals in Methadone Maintenance Treatment (MMT), and individuals with a history of alcohol, drug and alcohol, and other opiate use. In order to conduct this research, a number of preliminary steps were conducted.

Firstly, a sample of university students who reported no regular alcohol or drug use was recruited from the University of Waikato in Hamilton to determine the appropriateness of overseas psychometric norms for use in the New Zealand context. The findings of this study (*Experiment 1*) showed that the normative data provided for each of the psychometric measures was applicable in a New Zealand setting. As such, the psychometric measures were used in later studies. Additionally, the results of this study suggest that the normative data for the administered psychometric tests can be used in other research, and in clinical settings within New Zealand.

In parallel to *Experiment 1*, a sample of university student who reported regular alcohol and/or substance use were recruited from the University of Waikato to explore the cognitive deficits of non-dependent alcohol and cannabis users. Individuals in this sample were initially recruited as part of *Experiment 1* but were excluded from this sample based on their alcohol and/or substance use. The findings of this study suggested that there was no impairment in the cognitive functioning of university students who consume alcohol regularly, however, increased frequency of alcohol use was associated with decreased performance on a problem solving task. Cannabis use was associated with poorer problem solving ability, and a greater frequency of cannabis use was associated with poorer memory functioning.

The findings for *Experiment 2* suggest that while impairments in cognitive functioning are seen in longer-term cannabis and alcohol users, these same impairments were not apparent in university students with casual use. Frequency of use was, however, related to poorer performance on several measures suggesting that there is a link between cognitive impairments and alcohol/cannabis use that may become more apparent should the university students continue with their current use patterns. Additionally, the findings from *Experiment 2* showed that the administered

psychometric measures were sensitive to the effects of alcohol and drug use in casual users.

Experiment 3 was conducted to explore the cognitive deficits of a group of opiate dependent participants enrolled in MMT, and used the same measures administered in *Experiment 1*. In addition, this study examined the link between cognitive functioning and treatment adherence. Findings from this study suggested poorer memory, divided attention and cognitive flexibility, and mathematical ability in the MMT sample compared to the normative data, however, the mean sample scores were within one standard deviation of the normative mean. A relation was also found between treatment adherence and satisfaction with treatment, with lower satisfaction related to poorer adherence. Cohen's effect sizes suggested that scores on the measures of long-term verbal memory, academic ability with the exception of spelling, impulse control, depression, verbal intelligence, and some aspects of problem solving were associated with adherence. Surprisingly, however, those individuals with poorer adherence obtained better scores on these measures which contradicts previous research and suggests a link between poor adherence and cognitive impairment. This unusual finding may have been a factor of the adherence measure used in this study, although it may have also been attributable to the biased sample.

As mentioned earlier, the findings of *Experiment 3* were tentative as the sample consisted of only 15 individuals on the MMT programme at CADS in Hamilton. Recruitment of participants for this study was particularly poor, and as such, following this study the research approach was revised. For follow-up studies the number of administered measured was reduced, which subsequently reduced the administration time of the battery; additional recruitment locations were also added in an attempt to increase the number of participants who volunteered for the research (including those who did not regularly attend appointments at CADS); and the population being studied was expanded to also include individuals with a history of alcohol and drug use who were not on the MMT programme. These changes to the research approach resulted in two further samples – an additional sample of individuals in MMT, and a sample of drug and alcohol users who were not in MMT.

Experiment 4 reported on the Second Methadone sample obtained through recruitment at CADS and at the Needle Exchange in Hamilton. Despite the changes to the research approach, this sample was also small (14 participants) although findings

paralleled those found for the initial methadone sample in *Experiment 3*. The one exception to this was the there was no relation between any of the administered measures and adherence to treatment (although effect sizes did suggest possible relations). Cohen's effect sizes in this sample also suggested that poorer adherence was associated with better scores on long-term visual memory, simple attention, and aspects on problem solving ability, although the effect sizes suggested different associations compared to those found in *Experiment 3*.

In parallel to *Experiment 4*, *Experiment 5* explored the cognitive deficits of drug and alcohol participants including a sample of individuals in treatment for alcohol use, a sample in treatment for drug and alcohol use, and a sample of individuals who used, or had a history of, opiates other than methadone (both in an out of treatment). This study was conducted with the intention of seeing if the cognitive deficits found for both the MMT samples were unique to individuals on MMT, or were evident in other drug and alcohol populations. The findings from this study showed that all samples had poor memory ability, in particular visual memory; and that a large number of individuals in the samples had impairments in divided attention and cognitive flexibility. These results were similar to those obtained by the methadone samples in *Experiments 3* and *4*. In addition, the samples were comparable to the methadone samples in that no impairment was found in inhibition and impulse control, although the samples differed in problem solving ability. On the measure of problem solving, the alcohol sample showed the least impairment, followed by the methadone, drug and alcohol, and other opiate samples in that order.

A comparison of the data from the samples in *Experiment 5* to the data of the methadone samples showed that treatment satisfaction was significantly lower in the Methadone sample compared to both the Alcohol and Drug and Alcohol samples. This suggested that treatment dissatisfaction is related to specific aspects of MMT. For example, issues with daily dosing, and the implementation of treatment rules and regulations were commonly raised as issues of contention. These findings were, however, not specifically attributable to the MMT programme at CADS as previous research has reported similarly rates of satisfaction in other MMT populations (Deering et al., 2003; National Treatment Agency for Substance Misuse, 2007; Simpson, Joe, & Brown, 1997; Strang et al., 2000; Villafranca, McKellar, Trafton, & Humphreys, 2005). Therefore, a review of the delivery of MMT services is warranted

to assess the reasons for poor satisfaction further, and to identify changes that could be implemented to resolve these issues.

Based on the findings from the methadone samples in *Experiments 3* and *4*, and the drug and alcohol samples collected in *Experiment 5* a number of recommendations were made. Firstly, given the cognitive impairments that were shown in these samples it was recommended that services adapt their treatment approach to accommodate these deficits. For example, simplifying information to reduce attentional difficulties associated with divided attention, repeating information within and across sessions to help with recall of this information, and teaching approaches to solving problems may reduce the impact of deficits in these areas. In addition, it was recommended that providing reminders regarding appointments may improve treatment adherence in treatment services, and also result in better treatment outcomes.

Specifically in regards to methadone maintenance treatment, a number of additional recommendations were made based on the results of the TPQ. On the TPQ, the methadone samples were found to be significantly less satisfied with treatment, with participants outlining a number of areas in which treatment could be improved. Based on these comments it was recommended that treatment services address the inconsistency with which rules are applied (e.g. number of takeaway doses, consequences for not applying with treatment regulations), and that individuals in MMT are included in decisions regarding their treatment.

The relation between the adherence and psychometric tests results in the current research did not follow the pattern expected for the methadone samples. While the findings from *Experiment 3* suggested that poorer adherence was associated with lower levels of treatment satisfaction, this finding was not replicated in *Experiment 4*. Results for both methadone samples suggested that poor adherence was associated with better test performance, although the two samples did not obtain the same results with regards to the measures on which individuals had better performance. Therefore, the results for the methadone samples suggest that the adherence measure in the current research may not have represented adherence to treatment effectively, or alternatively, that the samples did not capture those individuals who did not attend appointments.

Adherence as measured for the Alcohol sample did, however, show that poorer adherence was associated with impairments in verbal memory, and sustained

attention, although the sample contained few individuals with poor adherence. The relation between treatment adherence and psychometric measures for the Alcohol sample suggest that adherence to treatment in drug and alcohol samples other than MMT may be measurable by the adherence measures used in this research.

Overall, findings for this research suggest that individuals in MMT programmes do have cognitive deficits; however, these deficits do not appear to be specific to those individuals in MMT programmes, as similar impairments were found in other drug and alcohol samples. When the results for the methadone samples in the present research were compared to overseas samples, the current methadone samples generally obtained scores that were less suggestive of clinically significant impairment. The findings for the methadone samples in this research suggest that there may be differences in the impairments seen in MMT populations in New Zealand, and that any impairments that are identified, may not be as severe as those found overseas. Future research with larger samples would be able to examine the findings of this research further.

One possible reason for the noted differences between the current methadone samples and those studied overseas is the variation in substances that are available. As mentioned previously, the incidence of heroin use is substantially lower than that seen in overseas countries, while the rates of cannabis use have been reported as higher (Field & Casswell, 1999; New Zealand Health Information Service, 2001; Wilkins, Casswell, Bhatta, & Pledger, 2002). Other demographic factors may have influenced the findings of the present study. For example, the higher premorbid IQ levels reported in the initial methadone sample may suggest better premorbid functioning rates that overseas which may mean that decreases in functioning are not as noticeable.

As mentioned previously, there were a number of issues encountered in the present research. While these have been discussed briefly following each of the Experiments, these are discussed in more detail in the following section.

Throughout the research, difficulties with recruitment were encountered. Recruited samples were smaller than anticipated, despite recruitment over several years and changes to the research approach which aimed to increase participation. Specifically, the small number of individuals recruited in *Experiments 3, 4* and *5* may be attributable to a number of factors. During the recruitment periods of this research there were a number of changes to the staff at CADS. The newly employed staff were

not always aware of the research, and staff changes also created disruption for the individuals in this service. As a result of the keyworker changes, the individuals may have been less likely to volunteer to participate in the present research.

Alternatively, the recruitment difficulties may simply indicate that alcohol and drug populations, and specifically MMT populations, do not readily volunteer for research. Individuals in these populations may be uninterested in research, or concerned that participation would lead to the identification of impairments in their functioning, and potential stigma associated with these impairments. Equally, a distrust of researchers and concern over how the findings of the research would be used, or difficulties attending appointments in order to participate in the research may have contributed to the poor recruitment rate.

Previous research studies have used incentives to encourage research participation, or have incorporated research into the existing treatment programmes. These approaches appear to be more successful in recruiting participants, and as such, may be a more effective approach to the recruitment of individuals within the drug and alcohol field. However, issues have been raised regarding the use of incentives in participant recruitment. In the current research, minimal incentives (i.e., coffee and biscuits) were offered to increase participation in the research. This limitation was put in place by the Ethical Committees that approved this research, due, in part, to previous research findings which have suggested that financial incentives for participation could be considered as coercion as they may aid the continued drug seeking behaviour of many substance using individuals (Cunningham, 1998; Galanter & Kleber, 1999; McCrady & Bux Jr., 1999). Therefore, the lack of monetary incentives offer in this research, may have contributed to the recruitment difficulties. Incorporation of the research into the treatment programmes that participants were enrolled in was not within the scope of this research.

The findings, in relation to treatment adherence, for the participants recruited for this research may have been biased, as only those individuals who arrived for assessment appointments were able to be interviewed,. Therefore, the samples may represent only those individuals who regularly attend treatment appointments. Inclusion of the Needle Exchange in *Experiment 3* was unsuccessful in rectifying this imbalance.

In addition to the potentially biased sample, the measures of adherence used in this research may have affected the findings, and the lack of significant findings when

treatment adherence was assessed in relation to the psychometric measures. In the current research, adherence in the MMT sample was assessed by attendance at doctor's appointments and number of missed methadone doses. These two adherence measures were chosen as this information was the only information routinely collected by CADS. Given that adherence to treatment incorporates aspects other than attendance at appointments, the measure of adherence used in this research is likely to have under-reported adherence in this sample. In addition, the number of missed doses as an adherence measure was found to be ineffective as none of the methadone participants had missed a dose of methadone within the last month. Again, this may suggest a bias in the sample, or it could be that individuals who miss methadone doses are not retained in the MMT programme. Given the limitations with both the adherence measures, and sample sizes in the current research, future research is warranted, with larger samples and with more robust adherence measures. At present, a large variety of adherence measures are used when researching this area. This lack of consistency across these studies makes this a difficult task. Therefore, future research that aims to develop a robust measure of treatment adherence for use with drug and alcohol populations would address this issue.

In addition to the issues surrounding the effectiveness of the adherence measures, the validity of the results obtained on two of the psychometric measures used in this research are questionable. While the majority of psychometric measures used in the present research were effective in identifying deficits associated with alcohol and/or substance use, the findings on the BAI and BDI-II raised some concerns. While the findings in *Experiment 3* using the BAI and BDI-II suggested that the initial methadone sample had elevated rates of both anxiety and depression compared to the normative population, a review of the literature, and discussions with the participants in this study highlighted that a number of the common side effects of methadone resemble symptomology assessed by these measures. For example, the BAI assesses symptoms of sweating, difficulty breathing, dizziness or light-headedness, and the BDI-II similarly assesses aspects such as changes in sleep patterns, and loss of interest in sex. All of these are commonly reported side-effects of methadone. Thus, it is difficult to determine if the reported symptoms on the BAI and BDI-II represent symptoms of anxiety and depression, or the result of the methadone treatment. Additionally, this finding suggests that high rates of benzodiazepine

prescription for this population may be the result of methadone side-effects that have been misdiagnosed as anxiety.

Overall, the findings from this research suggest that cognitive impairments are associated with drug and alcohol use in the New Zealand population. The current research, however, failed to find a relationship between these cognitive impairments and adherence to treatment in all but the Alcohol sample. As these findings contrast with those found previously in research overseas, further research is needed to explore these results in a New Zealand population. Additionally, future research could look at the difference between the demographics, and drug and alcohol use of New Zealand and overseas samples, and how these differences may account for the differing results.

The findings of the present study also suggest other directions for future research. In particular, future research could address the issues surrounding participant research, and aim to develop methods that allow a larger, and more representative sample of the population to be obtained; the need for a reliable and robust measure of adherence to treatment; and the limitations of using some psychometric measures with drug and alcohol populations.

With regard to treatment satisfaction, the current research has highlighted issues that need to be addressed within the current treatment settings, and considered in the development of new treatment options.

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APPENDIX I

Research Participants Needed!

Ever wondered what tests psychologists use? Or just wanted to see what research students do? If so read on ….

Hi, my name is Susan and I am a PhD student at the University of Waikato. I am looking for people who would be willing to complete some tests designed to test memory, attention, language and other cognitive functions. In other words, the tests examine how you remember things (like times, dates, experiences), how you plan and organise your time, how you solve problems, and how good your attention span is etc. I will also be asking some questions about your medical status, psychological status, drug and alcohol history and if you have ever had any head injuries.

Participation in this research would require approximately 2 hours of your time to complete a number of psychometric tests which you would get course credit for (up to 5%) if you are in 102 or 103.

If you are interested in participating in this research you can leave your name and contact details on this sign up sheet at the Psychology office. If you have any questions first you can email me on **sjy1@waikato.ac.nz** or leave a message at (07) 838 4080 ext. 4755. Alternately, you can contact my supervisors (Mary Foster and Nicola Starkey) if you have any questions or you can contact the convenor of the Research and Ethics Committee at the University of Waikato if you have any concerns about this research.

APPENDIX II

Consent Form

Testing of memory, attention, language and other cognitive areas

I have read and I understand the information sheet for volunteers taking part in the study designed to test memory, attention, language and other cognitive functions. I have been given the opportunity to discuss the research. I am satisfied with the answers I have been given. I have also been given a copy of the information sheet with contact details of the researcher if I wish to ask any questions at a later stage.

I understand that taking part in this research is voluntary (my choice) and that I may withdraw from the study at any time. I understand that my participation in this study is confidential and that no material which can identify me will be used in any reports on this study.

I _____ hereby consent to take part in this research.

Signed _____ Date _____

APPENDIX III

Demographic Information

Gender:

Age:

Ethnicity:

Handedness:

Academic achievement:
- highest level attained:

Number of Languages spoken (and is English first/second/third)

Medical Information

Do you have any major medical conditions? (eye conditions, hearing difficulties)

Are you taking any prescription medication on a regular basis?

Have you previously been hospitalised for a medical condition? If yes:

- what for and how long?

- any surgery (e.g. open heart)

Have you previously had any head injuries? If yes:

how many?

How long were you unconscious?

Did you require hospitalisation?

Have you ever been treated for psychological or emotional problems? If yes:

- diagnosis if known
- was this in the last 30 days?

Drug and Alcohol Information

Are you presently using any substance or alcohol on a regular basis? If yes, what?

e.g.

	Ever Used	Age of First Use	Frequency of Use
Alcohol			
Opioids			
Benzodiazepines			
Cannabis			
Hallucinogenics			
Inhalants			
Nicotine			
Amphetamines			
Other			

If yes, how many times in the past week?

If yes, how many times in the past 24 hours?

Have you previously, or continue to receive treatment for drugs or alcohol?

Have you ever had to be hospitalised due to an overdose resulting from alcohol or substance use? If yes:

What substance did you overdose on?

Did you become unconscious? If yes, for how long?

How long were you required to stay in hospital?

APPENDIX IV

Testing of memory, attention, language and other cognitive areas

Thank-you for participating in this research. If you decide at a later stage that you have any further questions about this research you can email me on sjy1@waikato.ac.nz or leave a message at (07) 838 4080 ext. 4755. Alternately, you can contact my supervisors (Mary Foster and Nicola Starkey) if you have any questions or you can contact the convenor of the Research and Ethics Committee at the University of Waikato if you have any concerns about this research.

Alternately, if you have any questions or concerns about

- your own drug and/or alcohol use
- someone else's drug and/or alcohol use
- your own mental health
- someone else's mental health

You can contact

- Community Alcohol and Drug Service, 40 Clarence Street (07) 839 4352
- The Drug Helpline (0800) 787 797
- Webhealth – www.webhealth.co.nz

And thanks again for participating in this research.

APPENDIX V

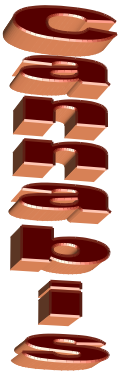
Using Recreational Drugs?

Do you currently use any recreational drugs?

If so read on ….

Hi, my name is Susan and I am a PhD student at the University of Waikato. I am looking for people who currently use recreational drugs who would be willing to complete some tests designed to measure memory, attention and other cognitive functions. In other words, the tests examine areas like how you remember things (like times, dates, experiences), how you plan and organise your time, how you solve problems, and how good you attention span is. I will also be asking questions about your medical status, psychological status, drug and alcohol history and if you have had any head injuries.

Participation in this research would require approximately 45 minutes of your time to complete a number of psychological tests which you would get 1 course credit for if you are in 102 or in 103.



If you are interested in participating in this research you can:

- leave your name and contact details on the sign up sheet at the Psychology office
- you can email me on sjy1@waikato.ac.nz
- you can call me on (07) 838 4755
- Or just pop past K1.04 and ask for Susan.

Other queries regarding this research can also be directed to Mary Foster & Nicola Starkey, or you can contact the convenor of the Research and Ethics Committee at the University of Waikato if you have any concerns regarding the research.

APPENDIX VI

Community Alcohol & Drug Service - METHADONE CONTRACT

Clients:
When you join the Methadone Programme you agree to certain conditions. Please read the following information carefully, if you have any questions please ask the Centre staff.

Starting the programme:

I …… agree

To provide my true name and address (residential & postal) with ID – either a passport or birth certificate.
To being observed for up to four hours after the first dose of Methadone.
To consume on Pharmacy premises daily for at least 3 months.
To undergo routine examination and blood tests and urinanalysis as required on admission.

Appointments:

I …….. agree
To keep all appointments with Doctors and Counsellors.

What if I am unable to keep an appointment?

It is your responsibility to ring the Centre within 48 hours and make another time.

What if I miss a 3 monthly review appointment?

It is your responsibility to advise the centre at least 48 hours beforehand if you are unable to attend. Should you miss the appointment without giving the necessary notice you will be required to consume methadone daily until you attend your next appointment.

What if I miss 2 consecutive appointments?

Your prescription will be stopped. The Medical officer is required by law to see you at least every three months in order to prescribe Methadone. If you fail to attend a review appointment, your Methadone prescription will be stopped on the day of your next appointment.
Centre staff can be reached during office hours 8.30 – 5pm.
If you want to leave a message after hours use the Centre night answer phone. Do not ring staff at home or other places of work such as Doctor's surgeries.

Centre staff agree to:

Treat you in a professional and courteous manner.
Give you medical and counselling appointments.
Provide you with HIV/AIDS testing (with your consent) as well as general medical testing, including Hepatitis C and B testing.
Arrange long term transfers to other centres - as long as you give appropriate notice and as long as you are accepted by the Centre (there are no guarantees)
Discuss changes in your Methadone dosage with you.
Keep personal details confidential – any information about you will only be shared with health professionals when it is necessary for your treatment. We need your permission to share information with anybody else unless there is significant risk to you or others.

Appropriate Behaviour at the Centre:

Centre staff have undertaken to treat you in a polite and professional manner.

I …….…….. agree that my behaviour at the centre will be courteous and co-operative.

Any from of violence towards Centre staff, or other clients at the Centre, will not be tolerated. If you behave in a violent way (this includes verbal threats) your case will be reviewed and you may be discharged from the programme.

Theft of property or damage to property in, or around the centre will not be tolerated either. If you behave in this way your contract will be reviewed and you may be discharged from the programme.

Takeaway Methadone:

I …… agree

Not to inject the takeaway Methadone or to supply the takeaway methadone to anyone else. (To ensure methadone is kept in a safe place and out of reach of children)
To accept responsibility for my takeaway Methadone, I understand that if the Methadone is dropped, stolen, vomited or lost – it will not be replaced.
To give Centre staff 48 hours notice if I want takeaway Methadone, and 2 weeks notice for a planned holiday. I understand that the whole team makes decisions about who may get takeaways. This decision will depend on my general progress and whether I have used takehome Methadone safely in the past.

Ongoing Treatment:

I ……. agree

Not to sell or exchange drugs, or set up drug deals on centre premises and pharmacy premises.
Not to use intoxicating drugs in or around centre property (this includes smoking cannabis)
No dogs on service premises.
Not to get intoxicating drugs from other Doctors. If I do, my contract will be reviewed and I may be discharged from the programme.
To provide urine samples as required. Sometimes these will need to be provided under observation.
To tell Centre staff if my address (Residential and Postal) and telephone number change.
Not to be involved in serious drug related criminal activities, this includes burglary of chemist/Dr Surgery, serious drug related charges etc. (see involuntary discharge section). Evidence of this may result in countdown and discharge from the programme.

Taking your Methadone at a pharmacy:

The pharmacist agrees to carry out the dispensing of Methadone prescriptions in a polite, professional manner.

I …… agree

To let the pharmacist supervise me taking the Methadone in the pharmacy.
To regularly pick up Methadone at the pharmacy.

Failure to pick up for two consecutive days will result in your script being cancelled:

You must tell the centre if you won't be picking up your methadone. If you don't do this, and don't attend the pharmacy for two days in a row, the pharmacist will be advised not to give you any more.

Not to discuss my Methadone dosage ad pickup arrangements with the pharmacist (ask centre staff)
To behave in an acceptable manner in the pharmacy

What will happen if I don't behave in an acceptable manner?

The pharmacist will inform the Centre and/or the police of any disorderly behaviour in the pharmacy. The pharmacist also has the right to refuse to dispense your Methadone. If the pharmacist refuses to dispense your Methadone it's your responsibility to find another listed pharmacy who would be prepared to do it.

Disorderly behaviour includes threats, verbal abuse, shop lifting, violence, drug diversion or any other type of behaviour which would be unacceptably disruptive or offensive to staff or customers.

Do not go to the pharmacy intoxicated by drugs or alcohol

What will happen if I do go to the pharmacy intoxicated?

The pharmacist won't give you your Methadone. The Pharmacist will telephone the clinic and tell staff what has happened and direct you back to the clinic.

If you fail to keep this contract the Team will review your contract which may result in count down and discharge from the programme.

Clients Signature: ..…….. Date: ……

Doctors Signature: …….. Date: ……

APPENDIX VII

New Research at CADS!!!

Hi, my name is Susan and I am a PhD student at the University of Waikato. I am wanting to do research with individuals on the Methadone Maintenance Treatment program (MMT). What this means is that we would like you to participate in some tests to see how you remember things (like times, dates, experiences), how you plan and organise your time, how you solve problems, and how good your attention span is etc.

Research in this area suggests that some people on methadone programs may have trouble with various aspects of thinking and decision making. Other research has found that some methadone users have trouble with their attention span, remembering things (like what someone's name was they have just met), and have difficulty solving problems. Another group of researchers found that the methadone users they studies seemed to show problems with planning (like deciding what order to do things in) and organisation (making sure you get everything done on time, making it to appointments on time).

Research suggests that these problems with how well you can do tasks may interfere with your daily life and how well you feel that your life is going. As you can see, there's lots of conflicting evidence, and it's really difficulty to try and work out the reasons why some people have difficulties and some don't.

We want to try and figure out what problems the methadone population is having in Hamilton and would like to get people to do tests to find this out. We also want to see if any of these difficulties (like not remembering things) are linked to not turning up to appointments, collecting scripts, or staying on the methadone program.

The type of tests we want to use are not scary (no blood tests, no heavy machinery!), and are things like problem solving tasks, memory skills, and pencil and paper tests (a bit like school, but we won't be giving you a grade on it). We would also like to know what you

think of the methadone program and if you think there is anything we could do to improve it. Hopefully all this will take no more than two hours, but if you have some spare time (as this part will require more of your time) we would also like to ask you some questions about your mood, previous drug use, medical history, legal history and employment history.

We hope that this research will help us to better understand people on methadone and make services more accessible. In addition, it is hoped that this research will help individuals by identifying difficulties they have and suggesting changes to present services to help in these areas.

We would like to know what you think about the research, if you have any concerns and if you think people on the methadone program would be interested in taking part. You can contact Susan or Vicki through CADS (07 839 4352). If you are interested in taking part in this research you can ask any of the staff at CADS about how to sign up.

REFRESHMENTS AVAILABLE

APPENDIX VIII

Testing of memory, attention, language and other cognitive areas of individuals on Methadone Maintenance Treatment.

About the research:

Hi, my name is Susan and I am a PhD student at the University of Waikato. I am wanting to do research with individuals on the Methadone Maintenance Treatment program (MMT). What this means is that we would like you to participate in some tests to see how you remember things (like times, dates, experiences), how you plan and organise your time, how you solve problems, and how good your attention span is etc. In addition, we would like to get your opinion on reasons for not making appointments, difficulties making use of keyworker sessions, and managing your methadone. It will take approximately 2 hours of your time to participate in this research.

In addition to this (for those people that are interested and have the time) we would like to ask you questions about your mood, previous drug use, medical history, legal history and employment history.

The type of tests we want to use are not scary (no blood tests, no heavy machinery!), and are things like problem solving tasks, memory skills, and pencil and paper tests (a bit like school, but we won't be giving you a grade on it). We also want to know what you think of the methadone program and if you think there is anything we could do to improve it.

We hope that this research will help us to better understand people on methadone and make services more accessible. In addition, it is hoped that this research will help individuals by identifying difficulties they have and suggesting changes to present services to help in these areas.

Your participation:

You do not have to take part in this research at all if you do not want to. You can also do part of the study but do not have to do all of it. At any time in the study, you can change

your mind and not answer questions or choose not participate. Participation or non-participation in the research will not adversely affect any present or future treatment that you receive. In other words if you don't want to be part of the research you will keep receiving your methadone just like before.

All the information you tell us will remain confidential, although with your consent may be discussed with staff at CADS. However, if you tell us that you are thinking of hurting yourself or someone else we will have to talk to other staff members about this. Whatever you tell us will not affect whether or not you can or cannot get services, so your honesty is appreciated.

Results of the study:
We will discuss a summary of the results of your testing with you if you would like. Also, if it is okay with you we would like to discuss you results with other staff members at CADS and put the results of your testing in your case notes.

All results from this study will be anonomised, and individuals will not be identifiable, as the results will be reported on as a group. Results from this research will be published, presented at conferences, and also presented at the Methadone Consumer Group meeting. A summary report at the end of the research can be provided for access by CADS consumers if you would like.

How to contact us:
If you are not happy about anything relating to this study or if you want to discuss your participation in the study, please contact Susan Yates c/o Community Alcohol and Drug Service, Hamilton on (07) 839 4352. Alternately, you can contact Vicki Barratt c/o the same phone number or Mary Foster/Nicola Starkey at the University of Waikato at (07) 838-4466. If you are wanting to discuss or voice any concerns about the research you can also contact the Health Advocacy on 0800 423638.

Approval:
This study has receiving ethical approval from The University of Waikato Ethics Committee and the Waikato Ethics Committee.

APPENDIX IX

Testing of memory, attention, language and other cognitive areas of individuals on Methadone Maintenance Treatment.

I have read and I understand the information sheet for volunteers taking part in the study designed to test memory, attention, language and other cognitive functions. I have been given the opportunity to discuss the research. I am satisfied with the answers I have been given. I have also been given an information sheet with contact details of the researcher if I wish to ask any questions at a later stage.

I agree for the researcher to review my relevant medical records and case notes for the sole purpose of gaining information for this study and to conduct a follow-up study in approximately 6 months time. I also understand that the researcher will record in my case notes that I have participated in this research.

I understand that taking part in this research is voluntary (my choice) and that I may withdraw from the study at any time and that this will in no way affect my present, or any future treatment. I understand that my participation in this study is confidential and that no material that can identify me will be used in any reports on this study.

As part of the research I understand that I will participate in some testing of things like memory, attention, and language. I would like to be informed of the results of my testing YES/NO
I agree for the results of my testing to be included in my case notes YES/NO
I agree for my GP or other current provider to be informed of the results of my participation in the research YES/NO

I _____ hereby consent to take part in this research.

Signed _____ Date _____

APPENDIX X

Demographic Information

Participant No: _____ Date of Interview: _____

Time of Administration: _____ Time on MMT: _____

Present methadone dose: _____ Gender: _____

Age: _____ Ethnicity: _____

Academic achievement: _____ Handedness: _____

Medical Information

Have you previously had any head injuries? _____

- How many? _____
- How long were you unconscious? _____
- Severity/did you require hospitalisation? _____

Drug & Alcohol Use

Age at onset of drug use:_____ Age at onset of opioid use: _____

Length of time using opiates: _____

Have you ever overdoses: _____

- How many? _____
- Severity/did you require hospitalisation? _____

Use of substances in last 48 hours (other than methadone): _____

Psychiatric

Curent Diagnoses:

APPENDIX XI

Date _____

To Whom It May Concern:

Please note that _____ has recently participated in a research project conducted at Community Alcohol/Drug Service designed to assess the cognitive functioning of individuals receiving Methadone Maintenance Treatment. As part of the research they completed the following test:

Wechsler Memory Scale-III-abbreviated
Trail Making Test
Stroop Color and Word Test
Wisconsin Card Sorting Test-abbreviated
Wechsler Individual Achievement Test-II-abbreviated
Beck Depression Inventory-II
Beck Anxiety Inventory
National Test of Adult Reading

If participants agreed to a record of their results being kept by Community Alcohol/Drug Service these results will be available at the end of the Research for review by qualified professionals.

Has the participant agreed for a record of their results to be kept on file at Community Alcohol/Drug Service YES/NO

Should you have any questions regarding the results prior to the completion of this research please contact Susan Yates on (07) 838 4755.

APPENDIX XII

Testing of memory, attention and other cognitive areas of individuals on Methadone Maintenance Treatment

About the research:

Hi, my name is Susan and I am a PhD student at the University of Waikato. I am wanting to do research with individuals on the Methadone Maintenance Treatment program (MMT). What this means is that we would like you to participate in some tests to see how you remember things (like times, dates, experiences), how you plan and organise your time, how you solve problems, and how good your attention span is etc. In addition, we would like to ask you questions about your previous drug use and previous treatment for drug and alcohol use that you may have received. It will take approximately 45 minutes of your time to participate in this research.

The type of tests we want to use are not scary (no blood tests, no heavy machinery!), but are things like problem solving tasks, memory skills, and pencil and paper tests (a bit like school, but we won't give you a grade on it!). We also would like to know what you think of the treatment services available at the Community Alcohol & Drug Service and if you think there is anything we could do to improve it.

We hope this research will help us better understand people who use substances and make treatment services more accessible. In addition, it is hoped that this research will help individuals by identifying difficulties they are having and suggesting changes to present services to help in these areas.

Your participation:

You do not have to take part in this research at all if you do not want to. You can also do part of the study but do not have to do all of it. At any time in the study, you can change

your mind and not answer questions or chose not to participate. Participation or non-participation in the research will not adversely affect any present or future treatment that you receive. In other words if you don't want to be part of this research you will continue receiving the same treatment that you already receive.

All the information you tell us will remain confidential, although with your consent may be discussed with staff at CADS. Whatever you tell us will not affect whether or not you can or cannot get services, so your honesty is appreciated.

Results of the study:

We will discuss a summary of the results of your testing with you if you would like. Also, if it is okay with you we would like to discuss the results with other staff members at CADS and put the results of your testing in your case notes.

All results will otherwise be anonomised, and individuals will not be identifiable, as results will be reported on as a group. Results from this research will be published, presented at conferences, and also presented at the Methadone Consumer group meeting, A summary report at the end of the research can be provided at the end of the research can be provided for access by CADS consumers if you would like.

How to contact us:

If you are not happy about anything related to this study, or if you want to discuss your participation in this study please contact Susan Yates on (07) 838 4755. Alternatively you can contact Mary Foster or Nicola Starkey at the University of Waikato on (07) 838 4466. If you are wanting to discuss or voice any concerns about the research you can also contact Health Advocacy on 0800 423 638.

Approval:

This study has received ethical approval from the University of Waikato Ethics Committee and the Northern Y Regional Ethics Committee.

APPENDIX XIII

Testing of memory, attention and other cognitive areas of individuals on Methadone Maintenance Treatment

I have read and I understand the information sheet for volunteers taking part in the study designed to test memory, attention, language and other cognitive functions. I have been given the opportunity to discuss the research. I am satisfied with the answers I have been given. I have also been given an information sheet with contact details of the researcher if I wish to ask any questions at a later stage.

I agree for the researcher to review my relevant medical records and case notes for the sole purpose of gaining information for this study. I also understand that the researcher will record in my case notes that I have participated in this research.

I understand that taking part in this research is voluntary (my choice) and that I may withdraw from the study at any time and that this will in no way affect my present, or any future treatment. I understand that my participation in this study is confidential and that no material that can identify me will be used in any reports on this study.

As part of the research I understand that I will participate in some testing of things like memory, attention, and language. I would like to be informed of the results of my testing YES/NO

I agree for the results of my testing to be included in my case notes YES/NO

I agree for my GP or other current provider to be informed of the results of my participation in the research YES/NO

I _____ hereby consent to take part in this research.

Signed _____ Date _____

APPENDIX XIV

Date _____

To Whom It May Concern:

Please note that _____ has recently participated in a research project conducted at the Community Alcohol & Drug Service in Hamilton designed to assess the cognitive functioning of alcohol and substance users. As part of the research they completed the following tests:

Wechsler Memory Scale-III-Abbreviated
Trail Making Test
Stoop Colour & Word Test
Wisconsin Card Sorting Test

If participants agreed to a record of their results being kept by the Community Alcohol & Drug Service, these results will be available at the end of the research for review by qualified professionals.

Has the participant agreed for a record of their results to be kept on file at the Community Alcohol & Drug Service YES/NO

Should you have any questions regarding the results prior to the completion of this research please contact Susan Yates on (07) 838 4755.

APPENDIX XV

Hi, my name is Susan and I am a PhD student at the University of Waikato. I am wanting to do research with individuals who attend the Community Alcohol & Drug Service in Hamilton. What this means is that we would like you to participate in some tests to see how you remember things (like times, dates, experiences), how you plan and organise your time, how you solve problems, and how good your attention span is etc. In addition, we would like to ask you questions about your previous drug use and previous and current treatment for drug and alcohol use. It will take approximately 45 minutes of your time to participate in this research.

Research in the drug and alcohol field suggests that individuals who use substances may experience difficulties with remembering things, planning and organising their time, and solving problems. As such we want to try and figure out what problems the substance using population is having in Hamilton and would like to get people to do tests to find this out. We also want to see if any of these difficulties (like not remembering things) are linked to not turning up to appointments, collecting scripts or staying in treatment.

The type of tests we want to use are not scary (no blood tests, no heavy machinery!), but are things like problem solving tasks, memory skills, and pencil and paper tests (a bit like school, but we won't give you a grade on it!). People have actually said these are quiet fun to participate in. Participation in this research would require approximately 45 minutes of your time, and drinks and food will be provided for those that are interested.

We hope this research will help us better understand people who use substances and make treatment services more accessible. In addition, it is hoped that this research will help individuals by identifying difficulties they are having and suggesting changes to present services to help in these areas.

If you would like to find out more about the research, or if you would be interested in taking part you can contact Susan on (07) 838 4755. If you have any concerns about the research you can also contact the Health Advocacy Service on Health 0800 423 638 or the convenor of the Research and Ethics Committee at the University of Waikato (Dr Robert Isler, phone: 838 4466 ext. 8401, e-mail r.isler@waikato.ac.nz).

APPENDIX XVI

Research Participants Needed

Hi, my name is Susan and I am a PhD student at the University of Waikato. I am wanting to do research with individuals who attend the Salvation Army in Hamilton. What this means is that we would like you to participate in some tests to see how you remember things (like times, dates, experiences), how you plan and organise your time, how you solve problems, and how good your attention span is etc. In addition, we would like to ask you questions about your previous drug use and previous and current treatment for drug and alcohol use. It will take approximately 45 minutes of your time to participate in this research.

The type of tests we want to use are not scary (no blood tests, no heavy machinery!), but are things like problem solving tasks, memory skills, and pencil and paper tests (a bit like school, but we won't give you a grade on it!). People have actually said they are quiet fun to participate in. Participation in this research would require approximately 45 minutes of your time, and drinks and food will be provided for those that are interested.

We would like to know what you think about the research, or if you would be interested in taking part you can contact Susan on (07) 838 4755. Alternatively, if you have any concerns regarding the research you can contact the Health Advocacy Service on 0800 423 638 or the convenor of the Research and Ethics Committee at the University of Waikato (Dr Robert Isler, phone: 838 4466 ext. 8401, e-mail r.isler@waikato.ac.nz).

APPENDIX XVII

Research Participants Needed

Hi, my name is Susan and I am a PhD student at the University of Waikato. I am wanting to do research with individuals who attend the Needle Exchange Service in Hamilton. What this means is that we would like you to participate in some tests to see how you remember things (like times, dates, experiences), how you plan and organise your time, how you solve problems, and how good your attention span is etc.
In addition, we would like to ask you questions about your previous drug use and previous treatment for drug and alcohol use that you may have received. It will take approximately 45 minutes of your time to participate in this research.

Research in the drug and alcohol field suggests that individuals who use substances may experience difficulties with remembering things, planning and organising their time, and solving problems. As such we want to try and figure out what problems the substance using population is having in Hamilton and would like to get people to do tests to find this out.

The type of tests we want to use are not scary (no blood tests, no heavy machinery!), but are things like problem solving tasks, memory skills, and pencil and paper tests (a bit like school, but we won't give you a grade on it!). People have actually said these are quiet fun to participate in. Participation in this research would require approximately 45 minutes of your time, and drinks and food will be provided for those that are interested.

We hope this research will help us better understand people who use substances and make treatment services more accessible. In addition, it is hoped that this research will help individuals by identifying difficulties they are having and suggesting changes to present services to help in these areas.

If you would like to find out more about the research, or if you would be interested in taking part you can contact Susan on (07) 838 4755. If you have any concerns about the research you can contact the Health Advocacy Service on Health 0800 423 638 or the convenor of the Research and Ethics Committee at the University of Waikato (Dr Robert Isler, phone: 838 4466 ext. 8401, e-mail r.isler@waikato.ac.nz).

APPENDIX XVIII

Testing of memory, attention and other cognitive areas of individuals attending the Community Alcohol & Drug Service

About the research:

Hi, my name is Susan and I am a PhD student at the University of Waikato. I am wanting to do research with individuals who attend the Community Alcohol & Drug Service in Hamilton. What this means is that we would like you to participate in some tests to see how you remember things (like times, dates, experiences), how you plan and organise your time, how you solve problems, and how good your attention span is etc. In addition, we would like to ask you questions about your previous drug use and previous treatment for drug and alcohol use that you may have received. It will take approximately 45 minutes of your time to participate in this research.

The type of tests we want to use are not scary (no blood tests, no heavy machinery!), but are things like problem solving tasks, memory skills, and pencil and paper tests (a bit like school, but we won't give you a grade on it!). We also would like to know what you think of the treatment services available at the Community Alcohol & Drug Service and if you think there is anything we could do to improve it.

We hope this research will help us better understand people who use substances and make treatment services more accessible. In addition, it is hoped that this research will help individuals by identifying difficulties they are having and suggesting changes to present services to help in these areas.

Your participation:

You do not have to take part in this research at all if you do not want to. You can also do part of the study but do not have to do all of it. At any time in the study, you can change

your mind and not answer questions or chose not to participate. Participation or non-participation in the research will not adversely affect any present or future treatment that you receive. In other words if you don't want to be part of this research you will continue receiving the same treatment that you already receive.

All the information you tell us will remain confidential, although with your consent may be discussed with staff at CADS. Whatever you tell us will not affect whether or not you can or cannot get services, so your honesty is appreciated.

Results of the study:

We will discuss a summary of the results of your testing with you if you would like. Also, if it is okay with you we would like to discuss the results with other staff members at CADS and put the results of your testing in your case notes.

All results will otherwise be anonomised, and individuals will not be identifiable, as results will be reported on as a group. Results from this research will be published, presented at conferences, and also presented at the Methadone Consumer group meeting, A summary report at the end of the research can be provided at the end of the research can be provided for access by CADS consumers if you would like.

How to contact us:

If you are not happy about anything related to this study, or if you want to discuss your participation in this study please contact Susan Yates on (07) 838 4755. Alternatively you can contact Mary Foster or Nicola Starkey at the University of Waikato on (07) 838 4466. If you are wanting to discuss or voice any concerns about the research you can also contact Health Advocacy on 0800 423 638.

Approval:

This study has received ethical approval from the University of Waikato Ethics Committee and the Northern Y Regional Ethics Committee.

APPENDIX XIX

Testing of memory, attention and other cognitive areas of individuals attending the Salvation Army

About the research:

Hi, my name is Susan and I am a PhD student at the University of Waikato. I am wanting to do research with individuals who attend the Salvation Army in Hamilton. What this means is that we would like you to participate in some tests to see how you remember things (like times, dates, experiences), how you plan and organise your time, how you solve problems, and how good your attention span is etc. In addition, we would like to ask you questions about your previous drug use and previous treatment for drug and alcohol use that you may have received. It will take approximately 45 minutes of your time to participate in this research.

The type of tests we want to use are not scary (no blood tests, no heavy machinery!), but are things like problem solving tasks, memory skills, and pencil and paper tests (a bit like school, but we won't give you a grade on it!). People have actually said these are quiet fun to participate in.

Your participation:

You do not have to take part in this research at all if you do not want to. You can also do part of the study but do not have to do all of it. At any time in the study, you can change your mind and not answer questions or chose not to participate. Participation or non-participation in the research will not adversely affect any present or future treatment that you receive. In other words if you don't want to be part of this research you will continue receiving the same treatment that you already receive.

All the information you tell us will remain confidential. Whatever you tell us will not affect whether or not you can or cannot get services, so your honesty is appreciated.

Results of the study:

We will discuss a summary of the results of your testing with you if you would like. All results will otherwise be anonomised, and individuals will not be identifiable, as results will be reported on as a group. Results from this research will be published, presented at conferences, and also presented at the Methadone Consumer group meeting, A summary report at the end of the research can be provided at the end of the research if you would like.

How to contact us:

If you are not happy about anything related to this study, or if you want to discuss your participation in this study please contact Susan Yates on (07) 838 4755. Alternatively you can contact Mary Foster or Nicola Starkey at the University of Waikato on (07) 838 4466. If you are wanting to discuss or voice any concerns about the research you can also contact Health Advocacy on 0800 423 638 or the convenor of the Research and Ethics Committee at the University of Waikato (Dr Robert Isler, phone: 838 4466 ext. 8401, e-mail r.isler@waikato.ac.nz).

Approval:

This study has received ethical approval from the Research and Ethics Committee at the University of Waikato and the Northern Y Regional Ethics Committee.

APPENDIX XX

Testing of memory, attention and other cognitive areas of individuals attending the Needle Exchange Service

About the research:

Hi, my name is Susan and I am a PhD student at the University of Waikato. I am wanting to do research with individuals who attend the Needle Exchange Service in Hamilton. What this means is that we would like you to participate in some tests to see how you remember things (like times, dates, experiences), how you plan and organise your time, how you solve problems, and how good your attention span is etc. In addition, we would like to ask you questions about your previous drug use and previous treatment for drug and alcohol use that you may have received. It will take approximately 45 minutes of your time to participate in this research.

The type of tests we want to use are not scary (no blood tests, no heavy machinery!), but are things like problem solving tasks, memory skills, and pencil and paper tests (a bit like school, but we won't give you a grade on it!).

We hope this research will help us better understand people who use substances and make treatment services more accessible. In addition, it is hoped that this research will help individuals by identifying difficulties they are having and suggesting changes to present services to help in these areas.

Your participation:

You do not have to take part in this research at all if you do not want to. You can also do part of the study but do not have to do all of it. At any time in the study, you can change your mind and not answer questions or chose not to participate. Participation or non-

participation in the research will not adversely affect any present or future treatment that you receive.

All the information you tell us will remain confidential. Whatever you tell us will not affect whether or not you can or cannot get services so your honesty is appreciated.

Results of the study:

We will discuss a summary of the results of your testing with you if you would like. All results will otherwise be anonomised, and individuals will not be identifiable, as results will be reported on as a group. Results from this research will be published, presented at conferences, and also presented at the Methadone Consumer group meeting, A summary report at the end of the research can be provided at the end of the research if you would like.

How to contact us:

If you are not happy about anything related to this study, or if you want to discuss your participation in this study please contact Susan Yates on (07) 838 4755. Alternatively you can contact Mary Foster or Nicola Starkey at the University of Waikato on (07) 838 4466. If you are wanting to discuss or voice any concerns about the research you can also contact Health Advocacy on 0800 423 638.

Approval:

This study has received ethical approval from the University of Waikato Ethics Committee and the Northern Y Regional Ethics Committee.

APPENDIX XXI

Testing of memory, attention and other cognitive areas of individuals attending the Community Alcohol & Drug Service

I have read and I understand the information sheet provided to volunteers taking part in this study designed to test memory, attention and other cognitive functions. I have been given the opportunity to discuss the research I am satisfied with the answers I have been given. I have also been given an information sheet with the contact details of the researcher if I wish to ask any questions at a later stage.

I agree for the researcher to review my relevant medical records and case notes for the sol purpose of gaining information for this study. I also understand that the researcher will record in my case notes that I have participated in this research.

I understand that taking part in this research is voluntary (my choice) and that I may withdraw from the study at any time and that this will in no way adversely affect my present, or future treatment. I understand that my participation in this study is confidential and that no material that can identify me will be used in any reports on this study.

As part of the research I understand that I will participate in some testing of things like memory and attention. I would like to receive feedback regarding the testing YES/NO

I agree for the results of my testing to be included in my case notes YES/NO

I agree for my GP or other current provider to be informed of the results of my participation in the research YES/NO

I _____ hereby consent to take part in this research.

Signed _____ Date _____

APPENDIX XXII

Testing of memory, attention and other cognitive areas of individuals attending the Salvation Army

I have read and I understand the information sheet provided to volunteers taking part in this study designed to test memory, attention and other cognitive functions. I have been given the opportunity to discuss the research I am satisfied with the answers I have been given. I have also been given an information sheet with the contact details of the researcher if I wish to ask any questions at a later stage.

I understand that taking part in this research is voluntary (my choice) and that I may withdraw from the study at any time and that this will in no way adversely affect my present, or future treatment. I understand that my participation in this study is confidential and that no material that can identify me will be used in any reports on this study.

As part of the research I understand that I will participate in some testing of things like memory and attention. I would like to receive feedback regarding the testing YES/NO

I agree for the results of my testing to be included in my case notes YES/NO

I agree for my GP or other current provider to be informed of the results of my participation in the research YES/NO

I _____ hereby consent to take part in this research.

Signed _____ Date _____

APPENDIX XXIII

Testing of memory, attention and other cognitive areas of individuals attending the Needle Exchange Service

I have read and I understand the information sheet provided to volunteers taking part in this study designed to test memory, attention and other cognitive functions. I have been given the opportunity to discuss the research I am satisfied with the answers I have been given. I have also been given an information sheet with the contact details of the researcher if I wish to ask any questions at a later stage.

I understand that taking part in this research is voluntary (my choice) and that I may withdraw from the study at any time. I understand that my participation in this study is confidential and that no material that can identify me will be used in any reports on this study.

I _____ hereby consent to take part in this research.

Signed _____ Date _____

APPENDIX XXIV

Demographic Information

Participant Number: _____ Date of Interview: _____

Location: _____ Gender: _____

Age: _____ Ethnicity: _____

Academic achievement: _____ Handedness: _____

If on MMT

Time of Administration: _____ Time on MMT: _____

Present methadone dose: _____

Medical Information

Have you previously had any head injuries? _____

- How many? _____
- How long were you unconscious? _____
- Severity/did you require hospitalisation? _____

Drug & Alcohol Use

Age at onset of drug use:_____ Age at onset of opioid use: _____

Length of time using opiates: _____

Have you ever overdoses: _____

- How many? _____
- Severity/did you require hospitalisation? _____

Current Treatment

Current Service receiving treatment from:

- ☐ Community Alcohol & Drug Service
- ☐ Salvation Army Bridge Program
- ☐ Other: _____
- ☐ Not currently in treatment

Receiving treatment for:

_____

Current drug use (type and frequency of use)

_____

Use of substances in last 48 hours:

_____

Psychiatric

Curent Diagnoses:

_____