Myopia for the Future? Decision-Making in Alcohol and Amphetamine Dependence

By
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This thesis is presented in partial fulfilment of the requirements for the degree of Bachelor of Psychology (Honours), Murdoch University
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I declare that this thesis is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary educational institution.

Lechi Vo
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Thesis Title: Myopia for the Future? Decision-Making in Alcohol and Amphetamine Dependence

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Abstract

Decision-making has been found to be a predictor for substance-dependence treatment outcomes (Bowden-Jones et al., 2005). Further understanding on decision-making and underlying factors may help tailoring treatment intervention for substance dependence. This study compared decision-making performance of a substance-dependent group after 56 days of abstinence with a control group using the Iowa Gambling Task (Bechara, Tranel & Damasio, 1997). Substance-dependent group were forty abstinent alcohol and amphetamine dependent individuals attending a residential substance dependent treatment program facility. Control group were forty four non-drug using volunteers. The Iowa Gambling Task is a decision-making test that emulates real-life scenarios involving risk, uncertainty, rewards and punishments, and is often used to examine decision-making performance of substance-dependent and other clinical populations. Consistent with past research, this study found that substance-dependent group performed significantly poorer relative to control group. This study also found the difference in the proportion of substance-dependent group relative to the control group who performed within the range of patients with ventromedial prefrontal cortices lesions statistically significant.

Together these findings indicated that a subgroup of abstinent substance-dependent individuals attending substance dependence treatment programs may still experience difficulties in decision-making domain after a protracted period of abstinence. The findings suggest the tendency for myopia for the future or being oversensitive to reward and insensitive to punishment associated with substance dependence may underlie the decision-making deficits in some substance-dependent individuals. Intensive cognitive and behavioural training were recommended to improve substance dependence treatment efficacy.
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1. **Introduction**

Substance dependence is a pervasive health problem in many industrialised nations including Australia, which can lead to social disruption to the community and a negative life impact to the individual. In Western Australia the two most common substances of dependence that individuals seek treatment for are alcohol and amphetamine (Marsh, Dale & Willis, 2007). It is therefore important to maximise the efficacy of substance dependence treatment programs. To achieve this there needs to be a greater understanding of the fundamental factors that contribute to treatment outcome so that better treatment strategies can be put in place.

Substance dependence is a mental disorder that is characterised by the compulsive use of alcohol and/or illicit drugs leading to clinical impairment (APA, 2004), and in Australia, approximately 10% of the population meet the Diagnostic and Statistical Manual for Mental Disorders IV (DSM IV, APA, 2004) at any one time (Teeson, Baillie, Lyskey, Manor & Degenhardt, 2006). Substance dependence is underlied by a set of physiological and psychological symptoms including tolerance to substance effects, withdrawal symptoms when substance use is discontinued, intense craving, compulsive seeking and taking of substance (APA, 2004). Past studies indicated that only a small percentage of individuals entering treatment programs remain abstinent for a sustained period of time despite the availability of different treatment options and known risk factors for relapse (e.g., Darke, Ross, Williamson & Teesson, 2004; Passetti, Clark, Mehta, Joyce & King, 2008). Furthermore, the understanding of known risks factors for relapse has shown to be
insufficient for effective management strategies in substance dependence treatment program
(Passetti et al., 2008). Additionally, the method for selecting the most appropriate treatment
for an individual is currently not available in clinical practice (Passetti et al., 2008). Thus, the
attempts to improve treatment efficacy have initiated a number of studies that focussed on
clarifying the underlying mechanisms for substance dependence, and the implications on
treatment outcome (Robinson & Berridge, 2003). One major line of research has focussed on
further understanding the effects of substance dependence on neurocognitive functioning and
their implications on treatment outcome (Verdejo-Garcia, Lopez-Torrecillas, Gimenex &
Perez-Garcia, 2004). Many studies have explored the effect of substance dependence on
neurocognitive functions including attention, learning and memory, and speed of processing
(e.g., Andrews & Collins, 2009), however only a few studies have focussed on the effects of
substance dependence on decision-making and its implications on treatment outcome
(Passetti et al., 2008). These studies suggest that poor decision-making, or the act of choosing
an option among several alternatives, can influence treatment outcome for individuals
attending substance dependence treatment program (Bowden-Jones, McPhillips, Rogers,
Hutton & Joyce, 2005; Passetti et al., 2008). Despite this evidence, the assessment and
incorporation of cognitive abilities for individuals entering substance dependence treatment
programs is still not an essential part of clinical practice (Ersche & Sahakian, 2007).

Therefore, the main aim of this study was to examine the effects of alcohol and
amphetamine dependence on decision-making and how decision-making impacts treatment
outcome. This study focussed on alcohol and amphetamine as they are the two most common
substances of dependence that individuals seek treatment for across Western Australian
dependence treatment facilities (Marsh et al., 2007). A deeper understanding of decision-
making process and its underlying factors may assist in tailoring the intervention for
substance dependent individuals. One example is to develop effective strategies to help substance dependent individuals overcome their decision-making deficit so that it minimises the impact on their treatment and also helping them in this area may also maximise their chance of remaining abstinence beyond treatment (Passatti et al., 2008). Thus better intervention strategies in turn may help to prevent relapse and improve treatment success rates.

There is an increasing amount of evidence which suggests associations between substance dependence and neuropsychological impairments. For example, heavy use of cannabis has been linked to attention (Ehrenreich et al, 1999; Solowij, Mitchie & Fox, 1995) and memory impairments (Croft, Mackay, Mills & Gruzelier, 2001). Deficits in memory and learning (Beatty, Katzun, Moreland & Nixon, 1995; Bolla, Funderburk & Cadet, 2000), attention (Toomey et al., 2003), response inhibition (Bolla et al., 2000), and abstract reasoning (Easton & Bower, 1996) have been shown in cocaine users. Amphetamine users have been found to have deficits in general memory (Morgan, 1999; Andrews & Collins, 2009), working memory (McCann, Mertl, Eligulashvili & Ricaurte, 1999; Wareing, Fisk & Murphy, 2000; Bechara & Martin, 2004; Andrews & Collins 2009), attention (McKetin & Mattick, 1997), cognitive flexibility (e.g., van der Plas, Crone, van den Wildenberg, Tranel & Bechara, 2009) and verbal fluency (Fox et al., 2002). Furthermore, neuropsychological evidence has linked prolong use of cannabis, amphetamines, heroin, cocaine, and alcohol to the damage in the prefrontal cortices, the brain regions that are believed to subserve executive functions (e.g., Grant, Contoreggi & London, 2000; Volkow & Fowler, 2002; Goldstein & Volkow, 2002).

As its name implies, executive functioning describes a group of high level of thinking processes which control and manage other cognitive processes such as attention and memory,
and motor skills (Lezak, 2004). In particular, it is believed that the executive system is involved when people are presented with situations that are novel, complex and beyond the domain of some of their automatic psychological processes that could be solved by invoking the learned schemas or set behaviours (Lezak, 2004). Furthermore, the executive system is also involved in situations where responses are not well-rehearsed, contain novel sequences of actions, or require the overcoming of a strong habitual response or resisting temptation (Lezak, 2004). These situations include planning, troubleshooting, organising, prioritising, conflicts resolving, difficult situations, riskiness, and uncertainty (Lezak, 2004). Furthermore, when facing such complex situations and having to make choices, people not only rely on their decision-making ability but also their executive functions as well as their ability to integrate the executive functions in a coherent manner (Lezak, 2004). Thus decision-making requires an individual to identify the pros and cons of each alternative, assess the risks and likelihood associated with each alternative and various outcomes or consequences, establish goals and evaluate each alternative to ascertain whether their goals are met (Lezak, 2004). In addition, an individual also needs to size up real world situations and analyse how best to achieve goals that have a high degree of uncertainty (Lezak, 2004). For example, on being presented with a potentially rewarding stimulus, such as alcohol, a social drinker (someone who have a drink or two occasionally), might have the automatic response to drink alcohol. However, if such behaviour conflicts with personal goals or social norm, their executive functions might be invoked to inhibit that automatic response, for instance refraining or moderating alcohol consumption because they are driving. An individual with intact executive functioning may deliberate on whether to drink or not by invoking their executive functions such as identifying the pros and cons, assessing the risks associated with drinking or contemplating possible negative consequences, an individual may inhibit their automatic response and decide not to drink.
However, it is believed that one particular aspect of decision-making that appears to be impaired in substance-dependent individuals is making choices in real life situations which involve risk, uncertainty, rewards and punishments (Bechara & Damasio, 2002; Gonzalez, Bechara & Martin, 2007, van der Plas et al., 2009). Indeed, using decision-making task that emulate real-life scenarios involving risks, uncertainty, rewards or punishment, many studies have found that chronic users of cocaine (Grant et al., 2000), opiate (Petry, Bickel & Arnett, 1998), alcohol (e.g., Bechara & Damasio, 2002), and amphetamine (e.g., Gonzalez et al., 2007) performed poorer compared to non-drug using participants. Their decision-making deficits are such that they tend to make choices based on immediate benefits or rewards despite possible future negative consequences, which is characterised as a tendency for myopia for the future (Bechara & Damasio, 2002).

One theory that attempts to explain this phenomenon is the somatic marker hypothesis which emphasises the role of emotions in decision-making (Damasio, 1994). This theory postulates that the emotional signals arising from different levels of the brain and the body (the autonomic nervous system), called somatic markers, or “gut feelings”, influence the reasoning process during decision-making (Damasio, 1994). The emotional signals help to reduce the complexity and the uncertainty of a problem by steering one away from options that are connected with unpleasant “gut feelings” through past experience and learning, and marking options that are promising so that they can be processed in a full cognitive fashion, which maximises the individual’s chance of selecting a good choice (Damasio, 1994). Damasio (1994) hypothesised that normal individuals are able to make good choices as they are able to develop the emotional-based signals or “gut feelings” for choices that led to bad outcomes (Damasio, 1994). Possible damage in the prefrontal cortex, specifically the ventromedial prefrontal cortex (VMPFC), as a result of chronic substance use many
substance-dependent individuals may make poor choices as they have less access to “gut feelings” (e.g., Bechara & Damasio, 2002; Bechara, Dolan & Hindes, 2002).

In addition, there are a number of other theories that may also explain the decision-making deficits observed in some substance dependent individuals (Dunn, Dalgleish & Lawrence, 2006). Some studies found that substance-dependence individuals who demonstrate poor working memory or poor cognitive flexibility are also impaired in decision-making (e.g. Bechara & Martin, 2004; van der Plas et al., 2009). In regards to working memory, Bechara and Martin (2004) argued that an important part of decision-making is to keep relevant information about the choices available in mind so that the information can be used in the reasoning process in guiding the final decision. Thus poor working memory may contribute to the poor decision-making (e.g., Bechara & Martin, 2004; Gonzalez et al., 2007; van der Plas et al., 2009). Similarly, it was proposed that decision-making requires an individual to have intact cognitive flexibility, or the ability to effectively switch between options and adjust their selections following feedback from previous performance (e.g., Errico, King, Lovallo, & Parsons, 2002; van der Plas et al., 2009). Thus poor cognitive flexibility can also lead to poor decision-making (e.g., van de Plas et al., 2009).

Furthermore, some studies suggest that poor decision-making could be attributed to individuals having the propensity to take risks rather than having good or bad decision-making ability (Weller, Levin & Bechara, 2009). One study found that normal participants, who obtained a higher score in a task that measure risk-taking behaviours also displayed a preference for risky choices in a decision-making test (Weller et al., 2009). In addition, some non-drug using control participants also displayed impaired decision-making ability despite normal neurocognitve performance (Bechara & Damasio, 2002). Therefore, this study also
aimed to explain the effects of chronic alcohol and amphetamine use on decision-making in light of these theories.

1.1. Decision-Making and Treatment Outcome

Poor decision-making can lead to negative life consequences for substance dependent individuals including loss of job, finance, and family (Bechara & Damasio, 2002). In addition, past evidence also suggest that poor decision-making can also have a negative impact on relapse and treatment outcome for individuals attending treatment programs (e.g., Bowden-Jones et al., 2005; Passetti et al., 2008). Bowden-Jones et al (2005) showed that alcohol dependent individuals were more likely to relapse within 3 months if they made more poor choices in a decision-making test which emulates real-life scenarios which require them to weigh up between risks and benefits, and between rewards and punishments (Bowden-Jones et al., 2005). Passetti et al (2008) found that individuals who abstained from substances at 3 months into treatment program performed significantly better in a decision-making test than individuals who did not (Bowden-Jones et al., 2005; Passetti et al., 2008). Bowden-Jones et al. (2005) explained the finding by suggesting that the impaired decision-making could be due to the dysfunctional VMPFC associated with chronic substance use, the consequences of which include the failure to plan ahead, to identify risks, to weigh between short-term gains against long term benefits, or to think adequately about the future consequences of their actions. In other words, substance-dependent individuals make poor decisions as they may be too focussed on immediate benefits which may then cause them to neglect future negative consequences (Bechera et al., 2001; Bechara & Damasio, 2002; Bowden-Jones et al., 2005; Passatti et al., 2008). It is apparent to see how such style of decision-making could impact the treatment outcomes of substance-dependent individuals attending treatment program (Bowden-Jones et al., 2005; Passatti et al., 2008). During their attendance in treatment
programs, substance-dependent individuals were encouraged to learn new behavioural, cognitive and emotional strategies to better cope with stress and difficult emotions, and alternative behavioural repertoires to prevent relapse (Baker, Kay-Lambkin, Lee, Claire, & Jenner, 2003; Marsh et al., 2007). However, in the presence of drugs, the effects of drugs would trigger a strong emotional response so that an individual may be too drawn to these reinforcing effects, which may cloud over their reasoning and judgement process (Bowden-Jones et al., 2005; Passetti et al., 2008). In other words, perhaps the individual is too focussed the immediate rewards and pleasure that drugs would bring, which may then obstruct them from seeing the risk and the future consequences of their actions (Bechara et al., 2001; Bechara & Damasio, 2002; Bowden-Jones et al., 2005; Passatti et al., 2008). Therefore, the individual is more likely to relapse than to abstain, which subsequently may result in treatment dropout (Bowden-Jones et al., 2005; Passatti et al., 2008; Naqvi & Bechara, 2008). Based on similar rationale, the thoughts of drugs during drug-craving would also trigger strong emotional responses in substance-dependent individuals which could perhaps urge them to seeking drugs (Bowden-Jones et al., 2005; Passatti et al., 2008; Naqvi & Bechara, 2008). Thus it is more likely that they relapse rather than abstain.

1.2. Decision-Making and Treatment Intervention

The understanding of the correlations between level of neurocognitive functioning and treatment outcomes for substance-dependent individuals can assist with tailoring treatment programs for substance dependence (Verdejo-Garcia et al., 2004; Andrews & Collins, 2009). For example, Andrews and Collins (2009), a recent study that examined the correlations between neurocognitive functioning and treatment outcomes, found that chronic alcohol and amphetamine users who performed poorer in cognitive flexibility tests also reported a lower perception on their self-efficacy to abstain from substance use and their ability to regulate
negative emotions. Poor cognitive flexibility performance may interfere with an individual’s ability to develop alternative behavioural repertoires to prevent relapse, and generate alternative positive future outcomes to past situations leading to substance use, which thus decreases their perceived self-efficacy to refrain from substance use in a number of situations, and their ability to manage distressing emotions (Andrew & Collins, 2009). The difficulty in regulation emotions has been identified as defined characteristics of substance-dependence (Verdejo-Garcia, Bechara, Recknor & Perez-Garcia, 2007) and a strong predictor of future relapse (Moeller et al., 2002). As such, Andrews and Collins (2009) recommended revised strategies to be incorporated into treatment program to target these specific areas. For example, to address the difficulty to regulate negative emotions, they recommended strategies be put in place to help client to re-appraise their negative emotions when experiencing distressing situations or to re-direct their attention away from the negative emotions using relaxation and mindfulness techniques.

As poor decision-making can also have a negative impact on relapse and treatment outcome for individuals attending treatment programs (Verdejo-Garcia et al., 2004; Bowden-Jones et al., 2005; Passetti et al., 2008), further understanding on decision-making in substance dependence may help in tailoring intervention for substance dependence treatment program. For example, in-depth knowledge and understanding on decision-making of substance dependent individuals can assist with tailoring treatment programs for substance dependence such as developing effective strategies to help substance dependent individuals avoid situations in which they may experience drug craving or when they face drugs (Bowden-Jones et al., 2005; Passatti et al., 2008), or to improve their ability in weighing up the risks, benefits, and consideration of the long-term consequences of their choices (Passetti et al., 2008), and their ability to regulate distressing emotions (Andrews & Collins, 2009).
Furthermore, the understanding of individual differences in decision-making may also help to develop specific intervention strategies appropriate for each individual (Passetti et al., 2008). The improved intervention strategies may therefore enhance the efficacy of the treatment programs, as well as prognosis for individuals who seek treatments for substance dependence (Verdejo-Garciajo et al., 2004). Finally, better decision making may also help these individuals to choose more wisely which may improve financial and social aspects of their lives in the long term.

Hence, this study also aimed to examine the decision-making performance of alcohol and amphetamine dependent individuals and discuss its implications on treatment outcome. The focus of this study was on alcohol and amphetamine as they are the two most common substances of dependence that individuals seek treatment for across Western Australian dependence treatment facilities (Marsh et al., 2007).

1.3. Decision-Making Using the Iowa Gambling Task

To examine the decision-making performance of alcohol and amphetamine dependent individuals, this study used the Iowa Gambling Task (Bechara, Tranel & Damasio, 2000). The task involves 100 trials of selecting single cards from four different decks. Each deck has predetermined rewards and penalties such that two decks are advantageous (good) and two decks are disadvantageous (bad) to the participant (Bechara et al., 2000). The key feature of the task is to forego short-term benefit for long-term gain (see Bechara et al. (2000) for full descriptions of the Iowa Gambling Task). The Iowa Gambling Task resembles card games found in real life that emulates scenarios involving risks, uncertainties, rewards, and penalties (Damasio, 1994). The predetermination of rewards and penalties scheduling also reduces the possibility of random chance. For example the 9th card in Deck 2 will always yield the same penalty and reward for each participant (Bechara et al., 2000). Participants are told the goal of
the game is to win as much as possible. Participants are also advised to play until the game ends, which adds further risk and uncertainty as they have no control over when the game will terminate (Damasio, 1994).

The Iowa Gambling Task was chosen for this study as it has shown to be sensitive in detecting impairment in patients who have lesions in the ventromedial prefrontal cortex (Bechara, Anderson, Damasio, & Damasio, 1994; Bechara, Damasio, Damasio & Tranel, 1997; Bechara, Tranel, & Damasio, 2000; Bechara et al., 2001; Bechara & Damasio, 2002).

Using the Iowa Gambling Task to examine the decision-making performance of VMPFC patients, studies found that despite their intact intellectual and cognitive functioning, VMPFC patients tend to choose cards based on immediate large rewards despite being aware that such cards also yield larger and more frequent losses in the longer term (Damasio, 1994; Bechara et al, 1994; Bechara et al., 1997). These studies thus attributed their decision-making deficits to their oversensitivity to rewards and insensitivity to punishment or myopia for the future. Furthermore, these patients also had significantly lower skin conductance responses (SCR) while they pondered bad decks compared to control participants. SCR is a physiological measure that works based on the assumption that emotional arousals (e.g., anxiety, fear, excitement) induce a level of sweat generated by the sympathetic nervous system (Damasio, 1994). An abnormally low SCR when pondering bad decks indicates that these participants have weaker emotion associated with penalties, or insensitivity to punishment (Bechara et al., 1997). Bechara et al. (1997) thus suggests that decision-making relies on emotions or “gut feelings” associated with past learning, which consciously or unconsciously guides people towards good decisions. Bechara et al. (1997) also suggested that the damage in VMPFC precluded the triggering of “gut feelings”, as reflected in impaired level of SCR, explained for the poor decision-making performance of VMPFC patients in this task.
Over the past decade, the Iowa Gambling Task have been used to compare the decision-making performance of substance-dependent groups with non-drug using groups and have found significant group differences (e.g., Bechara & Damasio, 2002; Gonzalez et al., 2007; van der Plas et al., 2009). Of particular interest to this study includes Bechara et al. (2001), Bechara and Damasio (2002), Bechara et al. (2002), Gonzalez et al. (2007), and van der Plas et al., (2009) as these were a few studies that focussed in examining decision-making deficit of alcohol and amphetamine dependent individuals. In comparing the Iowa Gambling Task performance of a sample of alcohol and amphetamine dependent individuals after a minimum abstinence period of 14 days with a control group, and a group of VMPFC patients, Bechara et al (2001) and Bechara and Damasio (2002) found that substance-dependent individuals performed better compared to VMPFC patients but their performance was significantly poorer compared to the control group. They also found that a subgroup of their substance-dependent individuals generated a significantly higher level of SCR when they received rewards, and a lower level of SCR when they pondered bad decks compared to control participants. They thus suggested that similar to VMPFC patients some substance-dependence individuals are oversensitive to rewards and insensitive to punishments evident inferred by the respective higher and lower levels of SCR’s as an indication of somatic markers (Bechara & Damasio, 2002).

Upon examining the total net scores of all participants, derived by subtracting the total selections made from bad decks from the total of selections made from good decks, Bechara et al. (2001) found that a maximum total net score obtained by any VMPFC patient was fewer than 10 cards (Bechara et al., 2001). Closer examination of the total net scores of all participants, Bechara et al.(2001) found that the proportion of substance-dependent individuals who performed within the range of VMPFC patients was significantly larger relative to the control group. Bechara et al., (2001) thus suggests an association between
chronic substance dependence and dysfunctional VMPFC (Bechara et al., 2001). Bechara et al (2001) and other later studies (e.g. Bechara & Damasio, 2002; Bechara & Martin, 2004) also found a subgroup of control participants who performed within the range of VMPFC patients. Their poor performance in the Iowa gambling task was attributed to risk-taking by these researchers as they were non-drug using individuals who had normal neurocognitive functioning.

This study therefore also aimed to determine if there is an overlapping in the Iowa Gambling Task performance of the current samples with VMPFC patients using 10 as the cut-off score for impaired performance. This examination is important as it may further the understanding on the level of decision-making impairment associated with chronic use of alcohol and amphetamine.

Many studies have also used the Iowa Gambling Task as a decision-making test to gain further understanding the relationship between decision-making and other neurocognitive functions (e.g., Bechara & Martin, 2004; Gonzalez et al., 2007; van der Plas et al., 2009). Bechara and Martin (2004), Gonzalez et al.(2007) and van der Plas et al.(2009) found individuals with primary dependence to alcohol and amphetamine performed significantly worse than the non-drug using control participants in tests that measure working memory and the Iowa Gambling Task performance. They also found that poor working memory performance was significantly correlated with the poorer performance in the Iowa Gambling Task. Furthermore, van der Plas et al.(2009) found substance-dependent individuals also performed poorer in a measure of cognitive flexibility, and the poor performance in cognitive flexibility significantly contributed to their Iowa Gambling Task performance.

The results of these studies provide preliminary evidence that chronic alcohol and amphetamine use may be associated with the decision-making deficits as assessed by the
Iowa Gambling Task. These studies also suggest that deficits in working memory and
cognitive flexibility are also associated with decision-making deficits as measured by in the
Iowa Gambling Task (Bechara & Damasio, 2002; Gonzalez et al., 2007; van der Plas et al.,
2009).

However, the length of abstinence prior to the neurocognitive assessment in these
studies is varied and has not been controlled. Research evidence suggests that the chances of
detecting chronic or long term effects as opposed to recovery during the early stage of
abstinence or acute effects of substances is greater if assessment of neurocognitive
functioning is conducted after an abstinence period of 56 days (Selby & Azrin, 1998; Alessi,
Ballard, Kirk & Montalbano, 2001). The application of a minimum period of 14 days of
abstinence in Bechara and Damasio (2002), Gonzalez et al. (2007) and van der Plas et al
(2008) suggest that any neurocognitive deficits observed in their studies may only reflect
acute effects as opposed to chronic effects (Alessi et al., 2001; Bates, Voelbel, Buckman,
Labouvie & Barry, 2005). To increase the likelihood of detecting effects of chronic
substance dependence, this study assessed decision-making performance of substance
dependent individuals after 56 days of abstinence. Examination on chronic effects of
substance dependence is important as the outcomes may better predict the neurocognitive
changes induced by substances associated with outcomes across treatment, which may help in
tailoring substance dependence treatment interventions (Bowden-Jones et al., 2005; Passetti
et al., 2008; Andrews & Collins, 2009).

1.4. Aims and Hypotheses

This study addressed the following research questions: 1. Do alcohol and amphetamine
dependent individuals have poorer decision-making compared to their matched controls? 2.
Are there more substance-dependent individuals relative to their matched controls who perform within the range of VMPFC patients in decision-making?

Thus, the first aim of this study was to compare the decision-making performance of alcohol and amphetamine dependent individuals after an abstinence period of 56 days to a matched control group using the Iowa Gambling Task. As decision-making is predictive of treatment outcome (Bowden-Jones et al., 2005; Passetti et al., 2008), further understanding on the decision-making process may help tailoring intervention for substance dependent treatment programs. Based on past research (e.g., Bechara & Damasio, 2002; Gonzalez et al., 2007; van der Plas et al., 2009) it was hypothesised that alcohol and amphetamine dependent individuals would perform poorer in the Iowa Gambling Task compared to their matched controls. The second aim of this study was to determine if there were more substance-dependent individuals relative to control participants who performed within the range of VMPFC patients (i.e. net score < 10). As suggested by Bechara et al. (2001) a net score of 10 was the maximum score achieved by any VMPFC patient in their study. Based on Bechara et al. (2001), it was hypothesised that there would be more substance-dependent individual relative to control participants who obtained a total net score of less than 10.
2. Method

2.1. Participants

Control participants were 44 volunteers (30 males) who were recruited through advertisements on bulletin boards at Murdoch University, letter-dropping, and snowball sampling. Control participants were of English speaking background and had reported no prior history of psychiatric disorder, neurological disease, current substance dependency, mental retardation, or learning disability.

Substance-dependent individuals were 40 patients (27 males) who received substance dependence treatment at The Salvation Army’s Bridge Program in Perth, Western Australia. The substance-dependent individuals met the current DSM-IV (APA, 2004) of substance dependence at treatment entry, reported alcohol or amphetamine as the primary substance dependence, were 18 years or over, and had an abstinence period of greater than 56 days prior to the neuropsychometric assessment. The neuropsychometric test battery was administered to the substance-dependent individuals as part of another study.

In examining the associations between neurocognitive measures with substance dependence treatment outcomes, Andrews and Collins (2009) found no significant differences in any of the neurocognitive measures between these amphetamine dependent users relative to alcohol dependent users, especially with regards to executive functioning. These insignificant findings could probably be due to these individuals being polysubstance users (Andrews & Collins, 2009). As such, this study treated these alcohol and amphetamine dependent individuals as one group when comparing their performance with a control group.
Control participants were matched with substance dependent individuals on premorbid estimate of intellectual functioning, age, gender, and the number of years of education. Independent sample t-tests were used to determine if the two groups differ on relevant variables. As shown in Table 1 there were no significant differences between the control and the substance-dependent group on WTAR score (i.e. estimated premorbid IQ), age, or education (all $p$’s > .05). This indicates that the two groups were well matched on all of these characteristics. The groups however differed significantly on self-reported depression, anxiety, and stress scores as measured by the Depression Anxiety and Stress Scale (DASS21: Lovibond & Lovibond, 1995) with the substance-dependent group reported a significantly higher depression score with a violated homogeneity of variance ($M$ difference = 6.54; $t(67.94) = 4.56, p < .01$), a higher anxiety score ($M$ Difference = 3.27; $t(82) = 2.70, p < .009$), and a higher stress score ($M$ Difference = 6.10; $t(82) = 4.29, p < .01$). The mean scores for the substance-dependent group on these measures fall in the mild range for depression and anxiety, and the moderate range for stress. The mean scores for the control group fall in the normal range for depression and anxiety, and the mild range for stress.
Table 1
Demographic Characteristics and DASS 21 scores for Control and Substance-Dependent Group.

<table>
<thead>
<tr>
<th></th>
<th>Control Group (n=44)</th>
<th>Substance-Dependent Group (n=40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Premorbid IQ</td>
<td>0.41 (0.41)</td>
<td>0.40 (0.36)</td>
</tr>
<tr>
<td>Age</td>
<td>34.77 (12.14)</td>
<td>38.56 (8.51)</td>
</tr>
<tr>
<td>Years of Education</td>
<td>12.18 (1.39)</td>
<td>11.65 (2.43)</td>
</tr>
<tr>
<td>DASS Depression</td>
<td>5.18 (5.43)</td>
<td>11.73 (7.96)</td>
</tr>
<tr>
<td>DASS Anxiety</td>
<td>5.48 (4.75)</td>
<td>8.75 (6.33)</td>
</tr>
<tr>
<td>DASS Stress</td>
<td>9.54 (5.82)</td>
<td>15.65 (7.20)</td>
</tr>
</tbody>
</table>

2.2 Neuropsychometric Tests

The same neuropsychometric test battery, which had previously been administered to substance-dependent individuals, was administered to the control group. The neuropsychometric test battery includes tests that assess four cognitive domains: Memory and Learning, Attention, Speed of Processing, Executive Functioning (see Appendix A). The neuropsychometric tests were chosen for their sensitivity in detecting executive functioning deficits among a variety of psychiatric and neurologically impaired populations as well as substance dependent individuals (Delis et al., 2001; Bechara & Damasio, 2002; Scott et al., 2007; van der Plas et al., 2009).

As the main aim of this study was to compare the decision making performance between the substance-dependent group and the control group, only the Iowa Gambling Task is described. Also assessed were the participants’ test taking effort, estimated premorbid IQ,
and depression, anxiety and stress levels. The tests administration followed standard format and took approximately 90 minutes to complete. All test scores were transformed to standard scores using norms provided in each test’s manual. All test scores were then cross-validated by different student researchers to minimise errors. Each test is described below.

2.2.1. Decision-Making: The Iowa Gambling Task (Bechara, Tranel & Damasio, 2000).

Decision making performance was assessed using the computerised version of the Iowa Gambling Task (IGT) (Bechara, Tranel & Damasio, 2000). The Iowa Gambling Task consists of 100 trials on which four decks of cards labelled D1, D2, D3, and D4 appear. Participants select a card from any deck. Choosing a card from decks 1 or 2 yields a high reward per card but a net loss in the long term. Choosing a card from decks 3 or 4 yields a small reward per card but a net gain in the long term. Participants were advised that the goal of the game was to win as much money as possible, and if they were unable to win, they should avoid losing money as much as possible. Participants were also told that some decks incur more loss than others and that they can win if they avoid selecting from the worst decks. Participants were given an amount of $2000 within the game to start with and were advised to treat the play money as if it were real.

There is limited reliability information on the Iowa Gambling Task as it is not made up with test items as a conventional neuropsychological test (Dunn et al., 2006). However, it has demonstrated construct validity by detecting decision-making impairment in a wide variety of clinical populations including patients with lesions in ventromedial prefrontal cortex (Bechara, Anderson, Damasio, & Damasio, 1994; Damasio, 1994; Bechara, Damasio, Damasio, & Tranel, 1997; Bechara et al., 2001; Bechara & Damasio, 2002; Ernst et al., 2002; Ernst et al., 2003). Many studies that examined the effects of substance dependence on decision-making
have found significant differences in the decision-making performance using the Iowa Gambling Task between alcohol and amphetamine dependent individuals and normal participants (e.g., Bechara & Damasio, 2002). These studies are most relevant to this current study which focused on the effects of chronic alcohol and amphetamine dependence on decision-making.

The Iowa Gambling Task performance was scored by grouping each sequential set of 20 trials into five blocks (e.g., the first block included trial 1 to trial 20) to enable the behavioural performance to be monitored and analysed (e.g. Bechara & Damasio, 2002). The score for each block, or block net score, was determined by subtracting the total number of cards selected from bad decks (D1 + D2) from the total number of cards selected from good decks (D3 + D4) (e.g., Bechara & Damasio, 2002). A total score obtained for the entire task, or the total net score, was derived by summing net scores for all blocks. A higher total net score indicates a better performance.

2.2.2. Test of Test Taking Motivation: Rey 15-Item Memory Test (Rey, 1964).

The Rey 15-Item Memory test was administered to assess participant’s test taking effort and motivation. Rey 15-Item Memory test has been chosen as it is quick to administer and it has shown to be a valid measure for assessing insufficient effort on neuropsychological assessments among a variety of psychiatric and neurologically impaired populations (Lezak, 2004). Participants were presented with a stimulus card which contains 15 different items, which are made up of letters, numbers, and shapes arranged in three columns and 5 rows. Participants were advised that there are 15 different items to remember (with emphasis on different and 15) and they were required to reproduce them on a blank piece of paper after 10 seconds of exposure. The performance on Rey 15-Item test was scored according to the
number of items correctly reproduced. Scoring is out of 15 and total scores below 9 are suggestive of insufficient test-taking effort.

2.2.3. *Estimated Premorbid IQ: Wechsler Test of Adult Reading test (WTAR: Wechsler, 2001)*

WTAR was administered to estimate pre-morbid intelligence. It was chosen due to the strong correlation between reading ability and intellectual functioning in a normal population (Straus, Sherman & Spreen, 2006). Additionally, word reading and recognition ability is believed to be resistant to cognitive impairment due to aging and brain injuries (Strauss et al., 2006). WTAR is also a good predictor of WAIS III IQ score than demographic characteristics (e.g., age and years of education) (Strauss et al., 2006). Participants were given a list of 50 irregularly spelled words and were asked to pronounce them. WTAR performance is scored based on the number of correctly pronounced words, which has been co-normed with the WAIS III (Wechsler, 1997), enabling the calculation of estimated WAIS III IQ scores (Lezak, 2004). WTAR has high internal consistency and test-retest reliabilities (all $r$’s > 0.9), and high validity by its correlations with other measures of reading such as AMNART ($r = 0.9$), and WRATR ($r = 0.75$) (Strauss et al., 2006).
2.2.4 Depression, Anxiety, and Stress Scale 21 (DASS21: Lovibond & Lovibond, 1995)

DASS21 was used to measure participants’ current psychological state as anxiety and depression can influence performance on neuropsychological tests. DASS21 consists of 21 items designed to measure the severity of symptoms common to depression (DASS21 Depression), anxiety (DASS21 Anxiety) and stress (DASS21 Stress). DASS21 was chosen as it is short and thus is easy to administer. Participants were asked to indicate the presence of symptoms over the past week (e.g., I felt down-hearted and blue). Each item is scored from 0 (did not apply to me at all) to 3 (applied to me very much). DASS21 has sound internal consistency for each measure: DASS Depression ($r = .97$), DASS Anxiety ($r = .92$), and DASS Stress ($r = .95$) (Antony, Bieling, Cox, Enns & Swinson, 1998). It also demonstrated high concurrent validity across different cultural groups and clinical populations (Norton, 2007).

2.3 Procedure

Upon signing up for this study, participants were given a letter which informs them about the nature of the research, their involvement, the voluntary nature of their participation, their right to withdraw any time from the research without any prejudice, and the protection of their identity and anonymity (see Appendix B). Those who decided to participate were asked to sign a written consent form consenting to attending a semi-structured screening interview and the neuropsychometric test battery (see Appendix C). During the screening interview, participants were asked about their demographic information, educational and occupational history, medical and psychiatric history and substance use history (see Appendix D). After the screening interview, participants were individually administered the
neuropsychometric test battery. The tests were administered in the order of WTAR, DASS-21, Rey-15 Item Memory Test, and the IOWA Gambling Task. The tests were administered by trained student researchers under supervision. All testing was conducted in a quiet setting.

Participants, who scored 9 or above in the Rey-15 Item Memory Test, were considered as suitable candidates for matching as they demonstrated sufficient testing taking effort (Lezak, 2004). The WTAR scores were then transformed to standard scores, co-normed with the WAIS-III IQ score to allow the premorbid IQ to be estimated. Participants were then matched with substance-dependent individuals according to their WTAR estimated premorbid IQ, age, gender, and education. The control group was subsequently formed. After the test results have been collated and analysed, all participants were sent a brief written overview of their individual neurocognitive strengths, and were thanked for their participation.
3. Results

4.1. Iowa Gambling Task Performance Analysis

As the aim of this study was to determine if a group of alcohol and amphetamine dependent individuals were impaired in decision-making as assessed by the Iowa Gambling Task compared to a matched control group, the focus of the statistical analyses was to compare the performance of the two groups in this task. Assumption testing was conducted for all statistical analyses. The two-tailed significance level was set at 0.05. All statistical analyses were conducted using SPSS for Windows version 17.0.

As the substance-dependent and control group significantly differed in the depression, anxiety and stress scores based on the DASS21 measures, Pearson’s correlation analyses were conducted to determine if any of DASS21 measures correlate with the Iowa Gambling Task performance using the total net score. The results indicated a significant, negative but small correlation between total net score and score for DASS21 Depression ($r = -.27, p = .012$), DASS21 Anxiety ($r = -.31, p = .005$), and DASS21 Stress ($r = -.21, p = .052$). This indicated that depression, anxiety, and stress as measured by the DASS21 scales negatively impact the Iowa Gambling Task performance. The DASS21 Depression, Anxiety, and Stress scores were used as covariates for all further between-group analyses. As the groups were matched on estimated premorbid IQ, age, gender, and education, it was decided not to include these variables as covariates in any between-group analyses.

A repeated-measures analysis of covariance (ANCOVA) was then conducted to compare group performance with Group (Control, Substance-Dependent), and Block (Block1, Block2, Block3, Block4, Block5) as the independent variables.

\[^{1} p < .08\text{ is interpreted as significant}\]
The dependent variable was the block net score for each block \(((D3+D4) - (D1 + D2))\). Prior to the analyses, all block net scores were examined for errors, normality and homogeneity of variance assumptions. The box plots of net scores in Figure 1 showed some outliers across all
blocks with the exception of block 3, which subsequently contributed to the violation of normality assumptions for some of these blocks. However, skew and kurtosis values for these blocks indicated no major deviations from normality. Furthermore, based on the hypothesis that associates substance dependence to impaired decision-making, these outliers were therefore retained for the purpose of group comparison. The assumption test for homogeneity of intercorrelations (Box’s M) was met ($p = .001$). However, the equality of covariance matrices assumption test (Mauchly’s Test of Sphericity) was violated ($p = .001$) thus the Huynh-Feldt’s F-corrected values were reported where indicated.

**Figure 2.** Performance of Control Group and Substance-Dependent Group on the Iowa Gambling Task: The net scores: $(D3 + D4) - (D1 + D2)$ across different Blocks using Standard Errors as Error Bars.

Figure 2 shows the net scores from the Iowa Gambling Task as a function of Group and Block. As shown, for both groups the mean net scores are increasing as the task progressed. This indicated that both groups performed better as the task progressed. However, across all block the mean net scores for the control group are higher relative to the substance-dependent group. The mean score for block 1 is similar between the two groups. The mean
score for control group in block 2, block 3, block 4), and block 5 were respectively higher than the substance-dependent group’s mean scores for block 2, block 3, block 4, and block 5.

The ANCOVA results showed a significant main effect for Group, $F(1, 79) = 10.56, p = .002$. Pairwise comparison showed that the substance-dependent group had a significantly lower mean net score than the control group, $M$ Difference = -4.88, $p = .002$. This suggests that control group performed significantly better than the substance-dependent group overall. There was also a significant main effect for Block, $F(3.88, 79) = 11.26, p < .01$ (Huynh-Feldt) which indicates a significant improvement in the performance as the task progressed in both groups.

The results also showed an interaction effect between Group and Block, $F(3.88, 79) = 3.26, p = .013$ (Huynh-Feldt) indicating that the control and substance dependent group learnt at different rates across the blocks. Post-hoc tests using one-way ANCOVA showed no significant difference between group means for block 1, $M$ Difference = -0.44, $F(1, 79) = 0.06, p = .799$. However the substance dependent group obtained significantly lower mean net scores than the control group in all remaining blocks, block 2, $M$ Difference = -5.21, $F(1, 79) = 7.54, p = .007$, block 3 with a violated homogeneity of variance assumption, $M$ Difference = -5.92, $F(1, 79) = 9.86, p = .002$, block 4 with a violated homogeneity of variance assumption, $M$ Difference = -5.96, $F(1, 79) = 7.13, p = .009$, and block 5, $M$ Difference = -6.86, $F(1, 79) = 11.33, p = .001$. These results indicated that both groups performed similarly in block 1 but in all subsequent blocks the substance-dependent group performed significantly poorer relative to the control group in all subsequent blocks.

4.2. Examination of the Iowa Gambling Task Performance Using the VMPF
To gain further understanding on the extent of impairment on the Iowa Gambling Task performance, the total net scores for all participants were examined to determine if there was an overlap in their performance with the performance of VMPFC patients (i.e. net score < 10) (Bechara et al., 2001).

Figure 3. Normal distribution plots from Control Group and Substance-Dependent Group. The figure represents a distribution of the total net score of selected cards and the number of participants whose scores fall within the score range

Figure 3 shows the normal distribution plots for total net scores for the control group and the substance-dependent group. The normal distribution curve for the control group showed that the performance of control participants is more varied and many of whom obtained total net scores in the higher score range relative to substance-dependent individuals.
In contrast, there are more substance-dependent individuals whose total net scores fall at the lower end of the normal distribution curve compared to the control group. Further examination revealed that 70% of substance-dependent individuals (N=28) and 36% of control participants (N=16) performed below the cut-off score for impaired performance (i.e. net score < 10). Chi-square test for goodness of fit indicated that the higher proportion of substance-dependent individuals relative to control participants who performed within this range was significantly different than chance, $X^2(1, N =106) = 10.91, p = .001$. Significantly more substance-dependent individuals performed below this criterion may indicate a possible association between their poor performance in the Iowa Gambling Task and the dysfunctional ventromedial prefrontal cortex due to chronic substance dependence (Bechara et al., 2001). These findings suggest that 30% of substance-dependent individuals (N=12) who performed above the range of VMPFC patients, which implies that their performance is not impaired based on this criterion.
4. **Discussion**

This study aimed to further explore the decision-making impairment of alcohol and amphetamine dependent individuals after 56 days of abstinence. To do so, this study compared the performance of a group of alcohol and amphetamine dependent individuals in the Iowa Gambling Task against a control group matched for estimated premorbid IQ, age, gender and education. After controlling for group differences in depression, anxiety, and stress levels, which are known to negatively impacts the neurocognitive test performance (Lezak, 2004), several important findings emerged.

The finding showed that the substance-dependent group performed similar to the control group during the first 20 trials of the Iowa Gambling task, and both groups improved in their performance as the task progressed, as reflected in their increasing net scores across the blocks. Although their performance improved across the blocks, the substance-dependent group performed significantly poorer compared to the control group in all remaining blocks (i.e., block 2 to block 5). In other words, the control participants gradually shifted their preferences towards good decks and away from bad decks as reflected in their increasing net scores in the second, third, fourth, and fifth blocks. This indicated that the substance-dependent group performed poorer in decision-making in the Iowa Gambling Task compared to the control group. This finding therefore supported the hypothesis. This finding is consistent with past studies (e.g., Bechara et al., 2001; Bechara & Damasio, 2002; Bechara & Martin, 2004; Gonzalez et al., 2007; van der Plas et al., 2009) which also found that their substance-dependent groups’ overall performance in the Iowa Gambling Task was poorer compared to their control group, and their substance-dependent groups’ performance across the blocks were also significantly lower than their control group particularly in the final 3 blocks. This finding suggest that even after a protracted period of abstinence, this sample of
alcohol and amphetamine dependent individuals still demonstrated a decision-making impairment relative to their control groups as measured by the Iowa Gambling Task. This finding also suggests that this sample of substance-dependent individuals may have still experience difficulty in their executive functioning particularly in decision-making domain even after attending their treatment program for a protracted period of time. This finding also suggests that damaging effects of alcohol and amphetamine dependence may be long lasting and would take longer time to be resolved (Selby & Azrin, 1998).

The examination of net scores for all participants also showed that 70% of substance-dependent individuals versus 36% of control participants performed within the range of VMPFC patients (i.e., net score < 10). Furthermore, the statistical significance was also found in the difference between the proportions of substance-dependent individuals relative to the proportion of control participants who performed impaired within this range. This finding therefore supported the second hypothesis. This finding was also consistent with past findings (e.g. Bechara et al., 2001; Bechara & Damasio, 2002; Bechara & Martin, 2004). The proportion of substance-dependent individuals in this study who performed within the range of VMPFC patients were slightly higher compared to Bechara et al. (2001) (61%) and Bechara and Martin (2004) (63%) but lower than Bechara and Damasio (2002) (89%). This discrepancy could perhaps be attributed to different characteristics of substance-dependent samples being used across different studies such as length of abstinence, length of substance dependence and polysubstance use (Verjedo-Garcia et al., 2004). This finding suggests that the extent of decision-making impairment as found within this subgroup of substance-dependent individuals appears to be comparable to the extent of damage found in VMPFC patients. This finding perhaps also implicate a possible connection between chronic alcohol and amphetamine dependence and the dysfunctional ventromedial prefrontal cortex, at least
for this particular subgroup of substance-dependent individuals (Bechara et al., 2001; Bechara & Damasio, 2004).

The poorer performance of this subgroup of substance-dependent individuals showed that they had a preference for bad decks, or decks that yield immediate large rewards despite large future losses. This implied that they have a tendency for myopia for the future, or being oversensitive to rewards and insensitive to punishment (e.g.; Bechara & Damasio, 2002). Detailed analysis of their behavioural performance in the task provides evidence to support this claim. During the first 20 trials, most participants sampled all decks but may select more from deck 1 and deck 2 (bad decks as they yield immediate large rewards but followed with large penalties) first, which was evident in the negative and lowest net scores obtained in block 1 for both groups. The cards stacking in the Iowa Gambling Task is such that the second card on deck 1, and ninth card on deck 2 deliver large penalties (Damasio, 1994). Thus towards the end of the first block, most participants would have experienced some large rewards, and perhaps fewer large penalties. After experiencing the first large penalty, most control participants shifted their preferences to deck 3 and deck 4 (good decks as they yield smaller rewards but also smaller penalty), as reflected in their higher net scores for these blocks. In contrast, upon learning about the decks yield immediate large rewards (the bad decks), and having the tendency to be oversensitive to immediate large rewards (Bowden-Jones et al. 2005), substance-dependent individuals continued making more selections from the bad decks despite that they may have also been heavily penalised. This was reflected in lower net scores of this substance-dependent group in the later blocks compared to control participants. Their oversensitivity to rewards may also override the reasoning process required for decision-making including establishing goals, weighing the pros and cons of each
option, assessing risks associated with each option, and anticipating future outcomes. This may therefore explain their poorer task performance compared to the control group.

This explanation is consistent with past evidence which associates chronic substance use with executive dysfunction including the inability to withhold immediate desire for long term benefits (Kirby, Petry & Bickel, 1999; Bechara et al., 2001; Bechara & Damasio, 2002; Bechara et al., 2002, Bechara, 2005; Bowden-Jones et al., 2005). Beyond the Iowa Gambling, there is also a substantial body of past evidence to support the myopia for the future associated with substance dependence using other decision-making tasks. For example, using delay discounting task where participants are required to choose between small immediate rewards and delayed large rewards, many past studies have found that substance-dependent individuals significantly discount more delayed money rewards compared to control participants (Kirby et al., 1999; Vuchinich & Simpson, 1998; Petry, 2001; Coffey, Gudleski, Saladin, & Brady, 2003; Heil, Johnson, Higgins, & Bickel, 2006). Due to these consistent findings delay discounting has been suggested to be one of the fundamental features of substance dependence (Bickel & Johnson, 2003), the tendency to choose immediate rewards without careful consideration of future negative consequences or their action (e.g., Kirby et al., 1999; Vuchinich & Simpson, 1998; Petry, 2001).

It is also possible that somatic markers may have also influenced the performance of the Iowa Gambling Task. Proponents of the somatic marker hypothesis argue that the stacking of cards in Iowa Gambling Task is such that it is not possible for participants to precisely calculate the reward and penalty scheduling for each deck (Damasio, 1994). To do well participants need to logically analyse the options, and also be guided by “gut feelings” of goodness and badness for each deck acquired from being repeatedly exposed to different ratios of rewards and penalties for each deck (Bechara & Damasio, 2002). Based on this
rationale, control group in this study might have developed “gut feelings”, which thus guided them towards good decks (Damasio, 1994), which is evident in the control group switching over and selecting significantly more cards from good decks in the later blocks than the substance-dependent group. In contrast, by showing the preferences for bad decks despite being penalised, according to the somatic marker hypothesis, this substance-dependent group may not be able to access to or utilise their “gut feelings”, or perhaps their “gut feelings” were so weak that it did not steer them towards good decks (Bechara & Damasio, 2002). As emotional regulation difficulties have long been considered a defining characteristic of substance dependence (Verdejo-Garcia, Bechara, Recknor & Perez-Garcia, 2007; Fox, Axelrod, Paliwal, Sleeper & Sinha, 2007) thus there may be a possible associations between an substance-dependent individual’s ability to regulate emotions and decision-making in the Iowa Gambling Task (Werner et al., 2009). Indeed, Werner, Duscheck and Schandry (2009) suggested that substance-dependent individuals who experienced more difficulty in regulating emotions also performed poorer in the Iowa Gambling Task. Furthermore, Heilman, Crisan, Houser, Miclea & Miu (2010) also found that the decision-making performance in the Iowa Gambling Task was improved when normal participants used cognitive reappraisal as an emotion regulation strategy to reduce negative emotions. Together these findings indicate that the difficulty in regulating emotions in substance dependence could perhaps underlie the impaired decision-making performance of this sample of substance-dependent individuals (e.g. Werner et al., 2009; Heil et al., 2010).

These results also indicated that 30% of substance-dependent individuals performed above the range of VMPFC patients in the Iowa Gambling Task. Closer examination on the normal distribution curves of the total net scores for both groups showed that some substance-dependent individuals performed as well as control participants. This
finding is also supported by past studies (e.g., Bechara et al., 2001; Bechara & Damasio; Bechara & Martin, 2004). It could be that this subgroup of substance-dependent individuals may have some decision-making deficits, which was perhaps not being detected within the current setting (Bechara & Damasio, 2002). For example, these substance-dependent individuals may only display their decision-making impairment in the presence of drugs or drug cues (Bechara & Damasio, 2002). The administration of the Iowa Gambling Task conducted within an abstinent treatment facility as in this study, therefore may fail to detect their decision-making deficit (Bechara & Damasio, 2002). It could also be that a simulated card test such as the Iowa Gambling Task may not be strong enough to trigger the underlying processes that are required for decision-making which therefore failed to detect the decision-making impairment within this subgroup of substance-dependent individuals (Dunn et al., 2006).

The finding that 36% of control participants performed within the range of VMPFC patients (i.e. net score < 10) is also consistent with past findings. This proportion is comparable to Bechara et al. (2001) (32.5%) and Bechara and Damasio’s (2002) studies (37%). As this subgroup of control participants were non-drug using participants it was assumed that they have intact neurocognitive functioning and therefore their poor performance in the Iowa Gambling Task could be due to risk-taking (Bechara & Damasio, 2002). For example, these individuals may prefer decks that provide them most “sensation” rather than those that generate most profit (Dunn et al., 2006). Thus selecting more cards from bad decks could be due to the individual preference for risk rather than having good or bad decision-making ability (Dunn et al., 2006). This may be particularly more likely as there was no real monetary value involved in the task (Dunn et al., 2006). There is evidence to suggest that risk-taking was involved within this subgroup of control participants. In Figure 2, the significant increase
in scores from block 1 to block 2 represented by the steep slope perhaps indicates that towards the end of block 1 the control group may have learnt that deck 1 and deck 2 are bad decks, and decks 3 and 4 are good decks. The reduced rate of increase in scores from block 2 to block 4, as represented by the reduction of slope of the line, suggests that control participants may be exploring and experimenting with deck 1 and decks 2, or taking risk during this stage. The rate of increase again from block 4 to block 5 may indicate that control participants may be realising now that they ‘should’ stick to the good decks. This interpretation is consistent with a study which found that normal participants who rated themselves higher on risk-taking measure also performed poorer in the Iowa Gambling Task (Weller et al., 2009). It is also plausible that some individuals may make their choices by guessing alone, which has been reported by past evidence (e.g., Elliott, Rees & Dolan, 1999).

Of course risk-taking or guessing may also explain for the decision-making deficits of this subgroup of substance-dependent individuals (Dunn et al., 2006). However the behavioural performance of this subgroup of substance-dependent individuals may not provide evidence support risk-taking or guessing. If risk-taking or guessing had occurred, one would expect that this subgroup of substance-dependent individuals would have selected more cards from ‘risky’ decks and thus their net scores for most blocks would be degraded across the blocks and becoming more negative towards the end of the task. The gradual and consistent increase in the net scores from block 2 to block 5 as shown in Figure 2 (no significant increase in line slope) indicates that minimal risk-taking has occurred within this subgroup of substance-dependent individuals.

Similarly, if guessing was involved, there is a 50/50 chance of selecting a card from bad decks and thus net score performance would be 0 for each block. The increasingly positive
scores across the blocks suggest that the probability of guessing within this subgroup of
substance-dependent individuals is perhaps small.

Although there is past research evidence to suggest that deficits in working memory
contributes to deficits in decision-making in substance dependence (Finn, Mazas, Justus,&
Steinmetz, 2002) most researchers agree that this is not a reciprocal relationship (Bechara,
Damasio, Tranel, Anderson; 1998; Bechara & Martin, 2004; Hinson, Jamieson & Whitney,
2002; Gonzalez et al., 2007; van der Plas et al., 2009). This means that if an individual has
impaired decision-making it does not automatically imply that their working memory is
impaired (Damasio, 1994; Bechara & Martin, 2004). The consistent improvement in this
subgroup of substance-dependent individuals across the blocks indicated that they were able
to retain relevant information about the decks (e.g. decks that yields rewards or penalties) and
were able to use that information to their advantage. This therefore suggests that their
working memory was perhaps not impaired. Additionally, an important part of the Iowa
Gambling Task is to shift preferences towards good decks and away from bad decks, or
cognitive flexibility (Dunn et al., 2006). This sample of substance-dependent individuals
demonstrated that they were able to shift their responses to good decks as evident in their
increasing net scores across the blocks (although not at the same level as the control group).
This suggests that their cognitive flexibility performance was perhaps not impaired.
Furthermore, minimising the group differences in this study by controlling for factors that
are known to influence neurocognitive test performance (e.g. Lezak, 2004; Delis et al., 2001;
Fals-Stewart & Bates, 2003) including negative affects (depression, anxiety, and stress),
estimated premorbid IQ, age, gender, and education may further suggest that decision-making
impairment observed in this subgroup of substance-dependent individuals perhaps could not
be attributed solely to their deficits in their neurocognitive functioning. This interpretation
may contradict past evidence (e.g. Bechara & Martin, 2004; van der Plas et al., 2009). However, the correlations found between working memory deficits, or cognitive flexibility deficits and decision-making deficits in Bechara and Martin’s (2004) and van der Plas et al.’s (2009) studies may be due to their substance-dependent samples being significantly older than their respective control groups as age is an influencing factor on neurocognitive performance (Lezak, 2004). Additionally, the administration of neuropsychological assessment after a minimum abstinence period of 14 days in their studies may indicate that their findings may be results of withdrawal and detoxification effects during early stage of abstinence (Verdejo-Garcia et al., 2004) which may have altered the neurocognitive test performance in their samples.

In summary, these findings provide evidence to suggest that the decision-making deficits as inferred by in the Iowa Gambling Task performance within a large subgroup of substance-dependent individuals may be due to their tendency for myopia for the future, or being oversensitive to rewards and insensitive to punishments (Bechara et al., 2001; Bechara & Damasio, 2002; Bowden-Jones et al., 2005; Passetti et al., 2008). These findings also provide some evidence to suggest that the decision-making deficits as observed within this subgroup of substance-dependent individuals perhaps could not be explained by the deficits in working memory, cognitive flexibility, risk-taking, orguessing.

4.2. Decision-Making and Treatment Implications

Making poor choices in life can lead to many negative consequences for substance-dependent individuals such as the lack of jobs, money, family and friends (Bechara & Damasio, 2002). These findings suggest that a large proportion of substance-dependent individuals still tend to make choices based on the available, immediate short-term gains rather than on careful deliberation and consideration of the future consequences of their
actions (Kirby et al., 1999; Bechara & Damasio, 2002; Bechara, 2005). This also implies that these substance-dependent individuals may still experience difficulty in planning ahead, establishing goals, assessing associated risks, weighing the pros and the cons of their choices, considering the negative consequences of their actions, anticipating future outcomes, and acknowledging their substance dependence problem (e.g., Kirby et al., 1999; Bechara & Damasio, 2002; Bechara, 2005). Such cognitive style may interfere with their treatment efficacy in a several ways. Upon entering the Bridge Program, substance dependence individuals are encouraged to participate in activities that are provided by treatment program such as attend psychoeducational classes and individual counselling (Andrews & Collins, 2009). Additionally, they are also encouraged to experiment with different behavioural repertoires to prevent relapse, and to modify behaviours as necessary to allow them to better handle stressful situations (Andrews & Collins, 2009). During treatment, substance-dependent individuals are also required to abide to the rules and philosophies stipulated by the treatment program. To succeed, they need to demonstrate an ability to anticipate the positive future outcomes of their treatment so they can remain committed to the treatment (Fals-Stewart & Lucente; 1994; Aharonovich, Numes & Hasin, 2003). Failure to acknowledge their substance dependence as a problem and anticipate positive future outcomes may suggest that substance-dependent individuals may be less committed to their treatment and may engage in avoidance behaviours rather than cooperating with treatment activities or abiding to the rules and philosophies stipulated by treatment program (Andrews & Collins, 2009). Failure to meet the target treatment objectives may imply that these individuals are less likely completing their treatment program (e.g., Fals-stewart & Lucente, 1999).

Second, such cognitive style may interfere with a substance-dependent individual’s capacity to benefit from treatment (Bowden-Jones et al., 2005; Passetti et al., 2008). For
example as part of the cognitive training in substance-dependent treatment therapy substance-dependent individuals are required to develop alternative cognitive, behavioural and emotional strategies to prevent relapse (Bechara, 2005; Bowden-Jones et al., 2005; Passetti et al., 2008). The difficulty in their ability to plan, to establish goals, to assess risks, and to anticipate positive future outcomes may also suggest that these individuals may experience difficulty in their attempts to generate alternative effective strategies to avoid situations in which they may experience drugs or drug craving (Bowden-Jones et al., 2005; Passetti et al., 2008).

Third and most importantly, it may interfere with their ability to forego drugs for long-term benefits (Passetti et al., 2008). When encountering drugs in the real social world, the reinforcing values of drugs may be too great that the individual might be more likely to be governed by their immediate desires (Bowden-Jones et al., 2005; Passetti et al., 2008). The overwhelming emotions triggered by the desire may subsequently override their logical analysis of their situations (Bowden-Jones et al., 2005; Passetti et al., 2008). As such they may neglect or fail to consider the pros and cons of their actions, assessing the risks involved, and anticipating negative future outcomes (Bowden-Jones et al., 2005; Passetti et al., 2008). Consequently, they may succumb to drug use. As the reinforcing values of drug would be powerful during abstinence (Ciccocioppo, Martin-Fardon & Weiss, 2004) these individuals might likely relapse or may drop out from treatment program. Similarly, drug craving during abstinence may lead substance-dependent individuals to drug seeking as these individuals might be governed by the immediate desires, which cloud their judgement and reasoning process, which would likely result in relapse (Bowden-Jones et al., 2005; Passetti et al., 2008; Kirby et al., 1999; Bechara, 2005).

4.3. Practical application of the findings
As poor decision-making performance has been found to negatively impact treatment outcome (Bowden-Jones et al., 2005; Passetti et al., 2008), viewing treatment from the decision-making domain, could potentially improve treatment efficacy for chronic substance dependent users. This finding suggests that after deciding to undergo treatment for substance dependence, decision-making may be important to remain abstinence (Passetti et al., 2008). Evidence found in this study suggests that the tendency for myopia for the future associated with chronic substance use may underlie the decision-making deficits in a subgroup of substance-dependent individuals after a protracted period of abstinence. Perhaps, this could be the area that should be given more intensive cognitive and behavioural training for substance-dependent individuals who demonstrate the tendency for myopia for the future decision-making style. For example, in addition to the existing cognitive behavioural training that are already in place in substance dependence treatment program (e.g. generating alternative behavioural repertoires to prevent relapse), perhaps additional training on areas such as planning, establishing goals, assessing risks, and anticipating future outcomes may also help to reduce the negative impacts on their treatment. The Iowa Gambling Task may be a useful tool to identify such individuals so that further time and effort can be spent in their rehabilitation (Bowden-Jones et al., 2005; Passetti et al., 2008).

4.4. Limitations and future directions

The IGT version used in this study is a computerised version in which only play money is involved. Perhaps the incorporation of real money in the IGT may reveal more variations in the task performance (Bowman & Turnbull, 2003). Furthermore, this may also shed more light on the relationship between the Iowa Gambling Task performance and other possible contributing factors including emotions, working memory, cognitive flexibility as well as risk-taking. Second, this study relied on the control participants’ self-reported account of their
substance use history which may not be totally accurate. Due to strict matching on demographic characteristics (e.g., estimated premorbid IQ, age, gender and education), the sample sizes deployed were not as large as planned. Future research should replicate this study using large sample sizes to determine if similar findings can be revealed. Finally, the majority of substance dependent individuals in this study were poly-substance users with primary dependence on alcohol or amphetamine. Thus it is useful to keep in mind that impaired decision-making as inferred by the Iowa Gambling Task performance found may perhaps due to the results of chronic polysubstance use interacting with possibly other biological, social and psychological factors rather than the direct effects of chronic alcohol and amphetamine use.

4.5. Conclusion

The aim of this study was to further the understanding of decision-making of chronic alcohol and amphetamine dependent users using the Iowa Gambling Task. The finding indicates that even after a protracted period of abstinence a large proportion of this sample of substance-dependent individuals performed poorer in the Iowa Gambling task compared to their matched control group. This finding is consistent with past studies (e.g., Bechara et al., 2001; Bechara & Damasio, 2002; Bechara & Martin, 2004, Gonzalez et al., 2007; van der Plas et al., 2009). The finding also showed that a subgroup of substance-dependent individuals performed at a comparable level to the performance of patients with VMPFC lesions on this task. This finding is also supported by past research ((Bechara et al., 2001; Bechara & Damasio, 2002; Bechara & Martin, 2004). Thus this finding perhaps suggests some possible associations between chronic alcohol and amphetamine use and the dysfunctional VMPFC. This interpretation is also supported by past research (Bechara et al., 2001; Bechara & Damasio, 2002). The finding also provides evidence to suggest that the
tendency for being oversensitive to rewards and insensitive to punishments could have explained for the poorer decision-making performance within this subgroup of substance-dependent individuals. This interpretation is also consistent with past findings (e.g., Bechara & Damasio, 2002; Kirby et al., 1999; Bechara, 2005; Vuchinich & Simpson, 1998; Petry, 2001; Coffey, Gudleski, Saladin, & Brady, 2003; Heil, Johnson, Higgins, & Bickel, 2006). As the decision-making performance treatment outcomes, further understanding of decision-making style of substance dependent individuals can potentially help identifying areas of treatment that the individuals have problems with, which may result in higher relapse rate (e.g., Bowden-Jones et al., 2005; Passetti et al., 2008). Based on these findings, it is suggested that the Iowa Gambling Task may be a useful tool to identify individuals who have the tendency for myopia for the future decision-making style so that more intensive cognitive and behavioural training can be provided to them. This may potentially reduce the negative impacts on their treatment, which in turn may enhance their treatment outcomes.


Fox, H. C., McLean, A., Turner, J. J. D., Parrot, A. C., Rogers, R., & Sahakian, B. J. (2002). Neuropsychological evidence of a relatively selective profile of temporal


This thesis is written for the journal: *Journal of Substance Abuse and Treatment*

**AIMS & SCOPE**
The *Journal of Substance Abuse Treatment (JSAT)* features original reviews, training and educational articles, special commentary, and especially research articles that are meaningful to the treatment of nicotine, alcohol, and other drugs of dependence. *JSAT* is directed toward treatment practitioners from all disciplines (medicine, nursing, social work, psychology, and counseling) in both private and public sectors, including those involved in schools, health centers, community agencies, correctional facilities, and individual practices. The editors emphasize that *JSAT* articles should address techniques and treatment approaches that can be used directly by contemporary practitioners.

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   - training or educational article designed to provide guidelines or basic instruction for delivering a type of therapy or intervention.

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**STYLE**


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1. Manuscripts should be organized in the following format (and sections numbered or unnumbered as indicated): 1. Introduction, 2. Materials and methods, 3. Results, 4. Discussion, Acknowledgments, References, tables (each on a separate page), figure legends (listed as a group on one page [or more pages if necessary]), and figures (each on a separate page). Other descriptive headings and subheadings may be used if appropriate, and these would be numbered accordingly (e.g., 2.1., 2.2..).
2. Every effort should be made to avoid jargon, to spell out all abbreviations the first time they are mentioned, and to present the contents of the study as clearly and as concisely as possible.
3. The methods, apparatus (including manufacturer's name and address), and procedures should be identified in sufficient detail to allow other investigators to reproduce the result.
4. For experiments in which human subjects were studied, authors should indicate whether (1) subjects provided informed consent and (2) the procedures followed were in accord with the standards of the Committee on...
Human Experimentation of the institution in which the experiments were done or in accord with the Helsinki Declaration of 1975.

5. For drugs and chemicals, the generic name should be used at first mention and preferably thereafter. Trade names may appear in parentheses and should be capitalized.

6. Patients' names, initials, or hospital numbers should not be used.

7. References should be given for all discussions of previous studies and for all nonstandard methods used. Authors should ensure that reference citations follow the style outlined in the Publication Manual of the American Psychological Association and that all names and dates cited in the text have been checked against and match the information provided for the respective citations in the References to ensure spelling and year of publication are correct. Authors should also ensure that every text citation has a corresponding entry in the References and, conversely, that every entry in the References list is cited in the text. Finally, authors should ensure that References are complete and accurate by comparing the information provided against the original source.

8. The approximate positions of all tables and figures must be called out in the text, numbered according to the order in which they appear. Data appearing in the tables or figures should be summarized, not duplicated, in the text. All data cited in the text should be checked carefully against data displayed in respective tables or figures to ensure that they correspond. Any ambiguous symbols (e.g., the letter "O" versus the numeral "0," the letter "I" versus the numeral "1") should be clearly identified.

Acknowledgments: Authors should describe, in a section titled Acknowledgments and preceding the References list, (1) any financial support for the study or paper and (2) (if applicable) individuals who were involved in the study or of direct help in preparation of the manuscript. In addition, authors should acknowledge if a limited portion of the manuscript was presented, for example, as an abstract at a scientific conference or meeting or in a report form.

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1. all authors of the work, with surnames and initials (not full name) in inverted order.
2. year of publication in parentheses (followed by ending period).
3. title of journal article, chapter, or book.
4. facts of publication: (a) for journals: journal name in full, typed in Italics; volume number, typed in Italics; inclusive page numbers; and (b) for books: city of publication and publisher's name.

Examples of correct citation (including capitalization and punctuation) of commonly
cited media are as follows:


**Tables:** Each table should be typed on a separate page and double-spaced. If the table must exceed one typewritten page, all headings are to be duplicated on the second sheet. Very wide tables are difficult and expensive to typeset and should be avoided by dividing the data into smaller tables. Tables are to be numbered in the order in which they are cited in the text. Every table should have a title, and every column in the table, including the left-hand (stub) column, should have an abbreviated heading. All abbreviations should be defined (even if they have been defined previously in the text). And units of measurement should be indicated for all values. Vertical rules are not to be used, and horizontal rules are to be used only to separate sections (e.g., table title from column headings). All empty spaces or dashes should be explained. Footnotes to the table should be designated with superscript letters (a, b, c, etc.) cited in alphabetical order as the table is read horizontally. Asterisks (*, **, ***, etc.) are to be used for statistics in the table body and footnotes. If data obtained from any other source, published or unpublished, are used, permission for their use must be obtained (and submitted to the editorial office). In addition, appropriate credit must be provided as a footnote to the table.

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2. **Full Review:** After Initial Review, the manuscript is assigned to one Review Editor and to at least one other reviewer who is experienced in the topic areas of the manuscript. Reviewer guidelines are presented below as a service to authors. Review Editors and reviewers make recommendations to the Editor-in-Chief, who makes the final decision on acceptance and type of article.

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2. Read the manuscript on the site or print the PDF for later review.
3. Complete the review forms on the site.
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**Treatment Relevance of the Subject:** The first goal for JSAT is to provide useful information that will help the full range of clinicians and treatment practitioners treating individuals who are substance dependent. Two important questions for reviewers in this area are the following:

1. Is the topic relevant to the treatment of addiction as it is currently practiced? Or as it may be practiced in the future?
2. Is there sufficient background and rationale to engage clinically experienced treatment practitioners?

Failure of the manuscript to show relevance or rationale will be grounds for rejection. Relevance and rationale are not easily corrected in revisions.

**Client and Treatment Descriptions:** JSAT strives to provide useful and empirically validated guidelines for treatment providers in the real world. Thus, there should be a clear description of the patients/clients with whom the study was conducted. There should be adequate information about the treatment situation and the specific elements of the clinical procedures (if this is a treatment study). The level of detail expected here is that which would enable clinically experienced readers to
understand important procedural elements of the study. Better studies will have sufficient detail to enable sophisticated practitioners to replicate the treatments or interventions described. Important questions for reviewers in this area are the following:

1. Are client characteristics adequately described?
2. If the clients are a very select group, do the results from study of this group offer some important treatment information for a practitioner?
3. Are relevant aspects of the treatment environment and the treatment elements described in sufficient detail to provide an informative picture?

Failure to describe patients or treatments adequately is quite serious and must be clarified if the manuscript is to be published.

**Research Design and Methods:** *JSAT* requires that appropriate scientific methods be used in the study of treatments for substance dependence. Of course, judgment will be required regarding the appropriateness of some scientific methods. Thus, the first decision will be whether reasonable and appropriate methods were used. Clearly, it is not possible or even desirable that randomized controlled trials be used in all treatment research. At the same time, a clinically experienced reader should be able to understand the rationale for the design and methods and should be given sufficient detail to permit replication of the essential aspects of the study. Important questions for reviewers in this area are the following:

1. Is the rationale for the study clear? Do the procedures, measures, measurement points, and subject selection criteria follow from that rationale?
2. Are the methods appropriate to the question being asked? Does the study use appropriate measures?
3. Will the data collected by using this design and methods advance the understanding of substance abuse treatment?

Failure to describe analyses adequately or to use appropriate analyses should be communicated to authors and must be corrected before publication of the manuscript. Statistical analyses are very important but often subject to the particular tastes of specific reviewers and readers. Of most importance is whether the analytic strategy and individual analyses make sense, not whether the most contemporary analysis was done.

**Conclusions:** It is a particular disservice to the reader and to the treatment field in general when the conclusions of a study go beyond the logical limits of inference from that study. This is an especially important, but usually correctable, part of a manuscript. Important questions for reviewers in this area are the following:

1. Is there a section describing the limits of the study procedures or of the findings?
2. Is there an attempt to couch the conclusions within the logic and limits of the design, measures, and patient sample?
3. Are the limits on generalization described?
4. Are any erroneous impressions conveyed?

Failure to understand the bounds of what the result can realistically say to practitioners should be reviewed closely. Authors should be asked to confine generalizations within reasonable limits and to be judicious in what they recommend from the data presented. This is an important but usually correctable section of the manuscript.

**Writing Style and Grammar:** JSAT favors clear organization, an economical writing style, and a modest tone. There should be an obvious and appropriate organization to the work. If these aspects of style are seriously deficient, this can be grounds for rejection. Repetitive phrasing and discussion of unnecessary or unrelated material should be suggested for deletion. Exaggerations and hyperbole should also be suggested for deletion or rephrasing. Spelling, grammar, and choice of phrasing are editorial responsibilities; comments on these elements of style are helpful but not necessary and not part of the substantive review.

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**Appendix A**

Table 2 - Neuropsychometric Test Battery administered to Control and Substance-Dependent Groups

<table>
<thead>
<tr>
<th>Domain</th>
<th>Test/Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory and Learning</td>
<td>Rey Auditory Verbal Learning Task (RAVLT)</td>
</tr>
<tr>
<td>Attention</td>
<td>WAIS-III: Digits Span</td>
</tr>
<tr>
<td></td>
<td>D-KEFS Design Fluency</td>
</tr>
<tr>
<td></td>
<td>Condition 1: Filled Dots</td>
</tr>
<tr>
<td></td>
<td>Condition 2: Empty Dots</td>
</tr>
<tr>
<td>Attention</td>
<td>Digits Forward</td>
</tr>
<tr>
<td>Speed of Processing</td>
<td>Symbolic Digit Modalities Test (Written)</td>
</tr>
<tr>
<td>Executive Functions</td>
<td>Cognitive Flexibility</td>
</tr>
<tr>
<td></td>
<td>D-KEFS Color-word Interference</td>
</tr>
<tr>
<td></td>
<td>Condition 3: Inhibition</td>
</tr>
<tr>
<td></td>
<td>Condition 4: Inhibition/Switching</td>
</tr>
<tr>
<td></td>
<td>D-KEFS Design Fluency</td>
</tr>
<tr>
<td></td>
<td>Condition 3: Switching</td>
</tr>
<tr>
<td></td>
<td>WAIS-III Letter-number Sequencing</td>
</tr>
<tr>
<td>Verbal Fluency</td>
<td>D-KEFS Word Fluency</td>
</tr>
<tr>
<td></td>
<td>Condition 1: Letter Fluency</td>
</tr>
<tr>
<td></td>
<td>Condition 2: Category Switching</td>
</tr>
<tr>
<td>Working Memory</td>
<td>WAIS-III: Digit Backward</td>
</tr>
<tr>
<td>Decision Making</td>
<td>WAIS-III: Discrepancy Forwards-Backwards</td>
</tr>
<tr>
<td>Problem Solving</td>
<td>IOWA Gambling Task</td>
</tr>
<tr>
<td></td>
<td>D-KEFS Twenty Questions</td>
</tr>
</tbody>
</table>


Appendix B

Participant Information Letter

Project Title: Thinking skills and self-efficacy in a control group

I am Dr. Marjorie Collins, a clinical psychologist. I am conducting a research project on the usefulness of assessing thinking abilities in drug treatment. Three Psychology Honours students are assisting with this research (Matthew Walford, Rebecca Bilson, and Lechi Vo).

We are seeking participants for a control group, who will act as a comparison to people who are undergoing treatment for drug dependence. To participate, you will be required to be over 18 years of age; and not currently be dependent on alcohol or illicit drugs.

If you are interested in participating, you will be asked to fill out some questionnaires about your current emotional state and drug use (these take about 10 – 15 minutes). We will also ask you to complete some activities which assess your thinking skills (e.g. remembering lists of words; puzzles) which take about an hour. We will also ask some questions about your education, work and medical history.

If you agree to participate in this study, we will give you feedback on your individual strengths.

If you consent to participate, we will protect your confidentiality. All information is confidential and no names or other information that might identify you will be used in any publication arising from the study.

If you agree to participate in this study, please indicate your consent on the form attached. If you have any questions about this, please feel free to ask the researchers, or you may contact Dr. Marjorie Collins (M.Collins@murdoch.edu.au; 08 9360 2858).

You may also withdraw your consent to participate without giving a reason and without prejudice.

This study has been approved by the Murdoch University Human Research Ethics Committee (Approval No. 2010/093)
If you have any reservation or complaint about the ethical conduct of this research, and wish to talk with an independent person, you may contact Murdoch University’s Research Ethics Office (Tel. 08 9360 6677 (for overseas studies, +61 8 9360 6677) or e-mail ethics@murdoch.edu.au). Alternatively, please visit Murdoch University’s School of psychology website http://www.psychology.murdoch.edu.au/index.html and click on the e-mail link at the bottom of the page. Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.
Appendix C

Consent Form

School of Psychology

Thinking Skills in control and drug dependent groups

The information about this project has been given to me. I have received satisfactory answers to all questions I have asked. I agree to participate. I know that I can choose to stop at any time. I understand that all information provided by me is treated as confidential and will not be released by the investigator unless required to do so by law.

1. I agree voluntarily to take part in this study.
2. I understand I am free to withdraw from the study at any time without needing to give any reason, and that I may do so without prejudice.
3. If you would like a copy of a summary of the research outcomes, please tick this box: □
4. I understand that data collected from me may be used in future research but will not be personally identifiable to me.

Signature of Participant: ________________________
Date: ...../....../.......

(Name)
__________________________________________

Signature of Investigator: ________________________
Date: ...../....../.......

(Name)
__________________________________________

Signature of Chief Investigator: __________________________ Date: ...../....../.......

(Name)
__________________________________________
Neuropsychological Screening Interview

Name:_________________________Participant No:___________________

PERSONAL HISTORY
DOB:_________________________Age:_____________________Gender:______________
Place of Birth: __________________First Language:___________Handedness:___________

EDUCATIONAL HISTORY:
Last Year of schooling:________________Repeat Grades:____________________________
What type of student:________________Remedial Classes:__________________________
Favourite Subjects:_____________________________________________________________
Subjects Dislikes:_____________________________________________________________
Grades Achieved:_____________________________________________________________
Further Education:_____________________________________________________________

How did you find school?_____________________________________________________________________

Any problems?_______
Any learning difficulty (maths, language, coordination/hyperactivity?)__________________

OCCUPATIONAL HISTORY (Duties performed):________________________________________

Marital Status/Living Condition:_____________________________________________________

MEDICAL/FAMILY HISTORY:
Any serious illness?________________Neurological disease?___________________________
Psychiatric disorder?_______________Hospitalisations?_______________________________
Current medical problems?_________________________________________________________
Medications?_______________________________________________________________________
Headaches?_____________________________Head injuries?____________________________
Neurological test results? ____________________________ Neurosurgery? ________________

COGNITIVE CONCERNS

Do you experience any problems/changes in your thinking? ____________________________

If yes, please provide some examples_____________________________________________

When did this begin? _____________________________________________________________

How are they affecting your life? _________________________________________________

How often do you have these difficulties? __________________________________________

What are the physical symptoms? ________________________________________________

MEMORY

What’s your memory for names, numbers, recent events, appointments like____________

How to get somewhere? _______________ Where you left things? ________________

How would your family describe your memory? ______________________________________

Do they tell you your memory has changed? _______________________________________

ATTENTION/CONCENTRATION

Concentrating on long tasks ______________________________________________________

Following conversations _________________________________________________________

Distractibility watching TV _____________________________________________________

SPEECH/LANGUAGE

Word-finding difficulties (e.g. explaining to others) _________________________________

Understanding others _______________ Writing ______________________ Reading ______

PLANNING/ORGANISATION/PROBLEM-SOLVING

Generating/following steps of a sequence (e.g., cooking, planning your week, working out best way to do something, completing an activity) _________________________________

FLEXIBILITY/LEARNING

Adapting to changes/new situations _______________ Learning new tasks ____________

SPEED OF PROCESSING

Slowness in activities/thoughts ___________________________________________________
**VISUOSPATIAL/VISUOMOTOR ABILITIES**

Judging distances/dimensions __________________ Putting things together______________
Catching things __________________________ Putting keys in locks___________________

**ALCOHOL AND DRUG USE HISTORY**

<table>
<thead>
<tr>
<th>Drug Category</th>
<th>Ever Used? (Yes/No)</th>
<th>Total Years Used</th>
<th>Injection Drug Use</th>
<th>Year Last Used</th>
<th>Frequency of Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol</td>
<td></td>
<td></td>
<td>N/A</td>
<td></td>
<td></td>
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<tr>
<td>Cannabis</td>
<td></td>
<td></td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>marijuana, hashish, hash oil</td>
<td></td>
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<tr>
<td>Stimulants</td>
<td></td>
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<tr>
<td>cocaine, crack</td>
<td></td>
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<tr>
<td>Stimulants</td>
<td></td>
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<tr>
<td>methamphetamines – speed, ice, crank</td>
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<tr>
<td>Amphetamines/Other stimulants</td>
<td></td>
<td></td>
<td>N/A</td>
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<tr>
<td>ritalin, benzedrine, dextidine</td>
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<tr>
<td>Benzodiazepines/Tranquilisers</td>
<td></td>
<td></td>
<td>N/A</td>
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<tr>
<td>Valium, Librium, halcyon, xanax, diazepam, “roofies”</td>
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<tr>
<td>Sedatives/Hypnotics/Barbiturates</td>
<td></td>
<td></td>
<td>N/A</td>
<td></td>
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<tr>
<td>Amytal, seconal, dalmane,</td>
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<td></td>
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<tr>
<td>Substance</td>
<td>Use</td>
<td>Code 87</td>
<td>Code 88</td>
<td>Code 89</td>
<td></td>
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<td>---------------------------------</td>
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<tr>
<td>Quaalude, phenobarbital</td>
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<tr>
<td>Heroin</td>
<td></td>
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<tr>
<td>Street or Illicit Methadone</td>
<td>N/A</td>
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<tr>
<td>Other Opioids</td>
<td>N/A</td>
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<tr>
<td>Tylenol #2 &amp; #3, 282’s, 292’s,</td>
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<tr>
<td>percodan, percolet, opium,</td>
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<tr>
<td>morphine, Demerol, dilaudid</td>
<td>N/A</td>
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<tr>
<td>Hallucinogens</td>
<td>N/A</td>
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<tr>
<td>LSD, PCP, STP, MDA, DAT, mescaline, peyote, mushrooms, ecstasy (MDMA), nitrous oxide</td>
<td>N/A</td>
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<tr>
<td>Inhalants</td>
<td>N/A</td>
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<tr>
<td>(glue, gasoline, aerosols, paint thinner, poppers, rush, locker room</td>
<td>N/A</td>
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<tr>
<td>Other: (specify)</td>
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</tbody>
</table>

**a-If “ever used” is NO (1) for any given line, the remainder of the line should be left blank**

**b- Code 87 = Infrequent use (less than or equal 2 x/year)**

**Code 88 = Brief experimental use (less than 3 months lifetime use)**

**c – Frequency codes:**

0=no use
1= <1x/month 2= 1x/month
3=2 to 3x/month
4=1x/wk
<table>
<thead>
<tr>
<th></th>
<th></th>
<th>5=2 to 3x/wk</th>
<th>6=4 to 6x/wk</th>
<th>7=daily</th>
</tr>
</thead>
<tbody>
<tr>
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