Withdrawal and tolerance phenomenon in problem gambling

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Acknowledgements

Financial assistance for this Project was provided by the New South Wales Government from the Casino Community Benefit Fund. The views expressed in this report, however, are those of the authors. The authors wish to extend their grateful appreciation for the support provided by the Trustees and administrative staff of the Casino Community benefit Fund in funding this basis research.

In particular, we would like to thank the following organisations for participating in the research project by distributing questionnaire protocols to their clients:

- Wesley Gambling Counselling Services at Penrith and Surry Hills (gambling)
- Wesley Rehabilitation Services Ashcroft (alcohol and gambling)
- Maryfields Day Recovery Service Campbelltown (alcohol and gambling)
- Langton Clinic Surry Hills (alcohol and gambling)
- Gambling Care, Lifeline Canberra (gambling)
- The University of Sydney Gambling Clinic (gambling)

Ethics Declaration:
Ethics approval for this study was provided by:

- The University of Sydney Human Research Ethics Committee: HREC 6643, approved 24 March 2003
- The South Eastern Area Health Service Ethics Committee: HREC 03/178, approved 27 August 2003

Abstract

The phenomenological similarities between gambling and substance dependence, namely repetitive self-destructive behaviours, the presence of craving, withdrawal, tolerance, comorbidity between alcohol and gambling, response to Naltrexone and fMRI and neurotransmitter dysregulation has led to the conceptualisation of pathological gambling as an addictive disorder. Reflecting this is the application of diagnostic criteria adapted from substance dependence to pathological gambling despite the Diagnostic and Statistical Manual series of the American Psychiatric Association classifying the latter as a disorder of impulse control.

Tolerance and withdrawal are important features in that they suggest the presence of common neurobiological processes associated with neuroadaptation underpinning gambling and substance dependence disorders. The reported observation of increasing bet sizes to generate equivalent levels of excitement reflects the feature of tolerance. The drive to avoid aversive physiological and psychological withdrawal symptomatology motives the individual to persist in gambling in the face of severe adverse consequences.

The concept of gambling as an addiction is influential in determining approaches to treatment and rehabilitation, and in promoting the disease model of gambling. However, there are few empirical studies supporting the presence of tolerance and withdrawal frequently reported in the clinical literature. Moreover, there are no studies comparing the equivalence of tolerance and withdrawal between gambling and alcohol dependence.

The purpose of this study is to compare and contrast tolerance and withdrawal features in samples of gamblers and alcoholics as a preliminary attempt to test the addictions model of pathological gambling. We administered questionnaires eliciting data related to gambling demographics, withdrawal and tolerance to clients with alcohol, gambling or comorbid gambling and alcohol disorders seeking treatment. Results showed that while at face value, increases in bet size emulated tolerance, the motivation to do so did not support the notion of tolerance in the proper meaning of the term. Cognitive factors

related to winning rather than the desire to maintain levels of arousal was the main factor accounting for increases in bet size. This finding supported the cognitive and not the addiction model of gambling.

There was some evidence that pathological gamblers experienced similar levels of withdrawal symptom severity as compared to alcohol dependent participants. The implication of the findings is important in supporting the addiction model and the process of negative reinforcement that postulates that aversive physical and psychological withdrawal symptoms might be might be instrumental in precipitating relapse episodes and in maintaining persistence in gambling. Accordingly, counsellors treating pathological gamblers should focus on the enhancement of skills that allow clients to cope with aversive physical and psychological symptoms following cessation of gambling behaviour.

Introduction

Although the American Psychiatric Association's Statistical Manual of Mental Disorders (DSM) classifies pathological gambling as a disorder of impulse control (312.31 Impulse-Control Disorders Not Elsewhere Specified: American Psychiatric Association, 1980, 1987, 1994, 2000), a number of alternative conceptual models explaining its aetiology and maintenance have been advanced. These include unitary approaches which view pathological gambling as a disorder of addiction (Jacobs, 1988) or one falling within a spectrum of obsessive-compulsive disorders (Hollander, 1993) and those offering more complex formulations incorporating a range of biopsychosocial processes, differential pathways and multiple sub-types (Blaszczynski & Nower, 2002; Sharpe, 2002; Walker, 1992).

Although emphasising different aspects, the majority of these models share core components including the presence of erroneous perceptions and irrational cognitions, contingencies of reinforcement, neurotransmitter dysregulation and/or psychological vulnerabilities (Ladouceur, Sylvain, Boutin, & Doucet, 2002). Others have argued for a wider public health policy approach (Korn & Shaffer, 1999) that direct less emphasis on individual psychological factors in preference to broader socio-political influences.

Despite these varied models, the addiction model represents the predominant current theoretical paradigm that is applied to pathological gambling (Blaszczynski & Nower, 2002; National Research Council, 1999). This is evident in the deliberate decision to model DSM-IV diagnostic criteria on those used for substance abuse disorders (Lesieur & Rosenthal, 1991) and the application of clinical interventions derived from the substance-related disorders to the treatment of pathological gambling. Appendix one provides a comparison of the substance dependence and pathological gambling criterion items. However, it is relevant to note that in contrast to DSM, the International Statistical Classification of Diseases and related Health Problems 10th Revision Australian Modification (ICD-10-AM) (National Centre for Mental Health, 2000) does not consider pathological gambling as an addiction. In this nosological system, it is

considered a habit and impulse disorder without reference to psychological dependence, tolerance, withdrawal, or neuroadaptive features as core components.

Both historical and scientific influences have shaped the development of the addictions model of gambling. The formation of Gamblers Anonymous in 1957 and its adoption of the principles and philosophy of Alcoholics Anonymous set the general foundation for application of the disease model of addiction to gambling. The collaborative relationship between Gamblers Anonymous and Dr. Robert Custer, a psychiatrist, was subsequently instrumental in establishing the first hospital-based treatment centre for pathological gambling in the drug and alcohol unit of the Veteran's Administration facility in Brecksville, Ohio. Following this, a number of private hospital drug and alcohol facilities established specialised gambling treatment programs, for example, Taylor Manor, Baltimore and South Oaks, Amityville in addition to other Veteran's Administration centres.

In supporting the addictions model, researchers pointed to epidemiological surveys and clinical studies describing high rates of comorbidity between pathological gambling and substance abuse, and their phenomenological similarities, for example, excessive preoccupation, loss of control, persistent urges and continuation despite severe adverse consequences (Lesieur & Rosenthal, 1991). Similarities in neurobiological activity and genetic abnormalities found among gamblers and substance dependent subjects strengthen this position (Goudriaan, Oosterlaan, de Beurs, & Van den Brink, 2004). These findings have led to pathological gambling being described as an 'addiction without the drug' (Potenza, Steinberg, McLaughlin, et al., 2001), and Lesieur and Rosenthal (1991) asserting that with the exception of chasing losses, all diagnostic criteria "*…have their counterpart in alcohol, heroin, cocaine and other forms of substance drug dependence"* (p.7).

The concept of Addiction

Historically, the term 'addiction' was defined narrowly and restricted to recurrent substance-use associated with the presence of overwhelming compulsive urges, persistence in use despite significant substance-related problems, and the emergence of negative affective states when access to the substance is prevented (Bozarth, 1990;

Volkow & Fowler, 2000; American Psychiatric Association, 1994; Koob & Bloom, 1998). There were two primary features considered to reflect the process of adaptation at the neurochemical level: withdrawal and tolerance. Tolerance is the need to increase doses to generate comparable effects while withdrawal refers to a constellation of affective and physical symptoms that occurs during periods of abstinence.

Taken together, these two features formed the foundation for physiological dependence with repeated exposure to mood altering substances producing changes in neurotransmitter activity and in other brain regions associated with learning, memory and motivation.

There are several neurochemical models of addiction that, while emphasising different aspects, share a common belief that changes in dopaminergic neurotransmitter systems are responsible for structural and functional disturbances in brain circuits. Neurochemical studies have well established the central role of dopamine neurotransmitters in the positive reinforcing effects of a range of drugs (Koob & Bloom, 1998). The neural structures rich in dopamine are found in the mesolimbic, mesocortical and orbital-frontal structures of the brain. These include the ventral tegmental area, nucleus accumbens, orbitofrontal cortex, amygdala and hippocampus with these regions shown to be involved in the neurobiological substrates mediating reward sensitivity, associative learning, memory, expectancies, cravings and emotional and motivational changes during withdrawal (Goldstein & Volkow, 2002).

In brief, in the acquisition phase of addiction, the initial immediate effect of a drug of addiction is to stimulate dopamine-mediated neural reward circuits leading to the subjective experience of a positive ‘rush’ or ‘pleasurable state’. The individual is motivated to recapture the drug’s effect through continued use. Through operant and classical conditioning, the positive reinforcing effects of drugs come to be associated with a range of drug-related cues and environmental stimuli, with subsequent reward memories of its effect stored in the hippocampal area. Subsequent exposure to drug related cues become capable of eliciting strong cravings for the effect of a drug through cognitive-mediated expectancies and anticipation of reward and/or simultaneously, stimulation of reward hippocampal reward-memories through exposure to such cues.

The use of dopamine-stimulating drugs leads to changes in neurotransmitter functioning at the molecular level. In an attempt to maintain homeostatic equilibrium following repeated drug use, biological systems respond by decreasing either the sensitivity of dopamine receptors or the production of endogenous dopamine. These intrinsic opponent-processes are designed to counter the appetitive effects of drugs that disturb neurotransmitter systems in an attempt to restore balance (Solomon & Corbit, 1974). This reduction in sensitivity to dopamine produces to two important effects reflecting neuroadaptational processes: withdrawal and tolerance. Because of these compensatory opponent processes, increasingly more drugs are required to generate desired euphoric effects, that is, tolerance occurs, while falling levels of drugs in the body precipitate aversive withdrawal symptoms.

Withdrawal and tolerance phenomenon are said to play a central role in the maintenance phase of drug addiction with appetitive and aversive motivation playing a central role in the addictive cycle (Bozarth, 1994). Initially, the euphoric effects of drugs are highly reinforcing and lead to a shift in incentive-salience that is described variously as 'wanting', 'craving' or 'toxic motivation' (Koob & Moal, 1997; Bozarth, 1990). With repetition, greater incentive salience to drug-related stimuli occurs in line with the increasing sensitisation of the dopamine system (Robinson & Berridge, 1993). Concomitantly, the strength of the appetitive effects of drugs is sufficient to supplant those elicited by other reinforcers. Consequently, drug taking to the exclusion of other activities assumes the primary focus of the drug addict's attention with 'wanting' gradually being transformed into a sense of 'craving'. In this way, a downward spiral of addiction emerges where the addict focuses on taking drugs to the exclusion of all other social, personal and familial responsibilities and obligations.

Over time, motivational shifts following neuroadaptational changes occur such that the need to reduce or avoid aversive drug-withdrawal symptoms becomes the predominant reason for continued drug use and relapse episodes (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004). Addicts frequently report that self-reported urges and intentions to use drugs are associated with withdrawal symptoms, while coping with withdrawal-induced negative affective states are potent motivators for relapse (Baker, et al., 2004).This drive

to reduce aversive withdrawal states forms the basis for dependence in negative reinforcement models of addiction (Cappell & le Blanc, 1981; Hershon, 1977; Robinson & Berridge, 1993).

Non-substance addictions

The presence of neuroadaptive changes manifested by craving, tolerance and withdrawal defined early notions of addiction. More recently, a range of non-substance related repetitive self-defeating behaviours are incorporated within the domain of addictions: gambling, excessive work (workaholics), compulsive sexual behaviours, eating and over involvement in Internet use and computer games (Mule, 1981; Griffiths, 1996a, b). The move is away from the physiological determinants of addiction to psychological dependence.

Dependence describes a condition in which an individual is compelled to use a substance not medically needed with repeated use leading to impairment in health or social functioning. It is characterised by *'a cluster of physiological, behavioural and cognitive phenomena of variable intensity in which the use of a psychoactive drug (or drugs) takes on high priority. The necessary descriptive characteristics are preoccupation with a desire to obtain and take the drug, and persistent drug-taking behaviour. Determinants, and the problematic consequences of drug dependence, may be biological, psychological, or social, and usually interact.'* (World Health Organisation, 1993).

According to this definition, the central feature may be psychological in nature and manifested by a persistent or recurrent drive or motivation (compulsion) to engage in certain behaviours (drug taking) to produce a sense of pleasure (high), or to avoid discomfort (withdrawal symptoms, unpleasant cravings and/or affective states). It is not an all-or-none phenomenon but represents a continuous dimension ranging from zero to severe dependency. In this respect, Edwards, Gross, Keller, Moser, & Room (1977) provided a list of seven factors considered to distinguish dependence in alcohol but applicable to the broader domain of substance use. These included the narrowing of behavioural repertoires; salience of substance use; subjective awareness of compulsion;

increased tolerance; withdrawal symptoms; relief or avoidance of withdrawal symptoms through further consumption; and reinstatement effects after period of abstinence.

Evidence of neuroadaptive changes consequent to regular substance use (physical dependence) has lost its place as a necessary requirement for dependence since it is possible to manifest signs of psychological dependence in the absence of such neuroadaptive changes. For example, Shaffer (1996) argued that addiction existed separately from physical dependence as evidenced by patients receiving post-operative narcotics who are physically dependent on the substance yet display no addictive tendencies to continue its usage, or gamblers who seem psychologically dependent on a behaviour unrelated to substance use. Therefore, Shaffer concluded that the primary factor for an addiction is the *relationship* of the addicted person to an object rather than that by the object itself: "the confluence of psychological, social and biological forces" rather than a single factor (Shaffer, 1996, p. 466).

Gambling as an addiction

There are a number of factors influencing the view of gambling as an addiction. At face value, the repetitive nature of gambling, its persistence in the face of adverse consequences, excessive preoccupation, loss of control and tolerance and withdrawal features are consistent with those manifested by drug-addicted individuals. The role of dopamine in mediating reward pathways, effectiveness of Naltrexone in blocking reinforcing effects in gambling similar to drugs, similarities in fMRI responses to gambling and drug-related stimuli, and similar poor performance on gambling tasks between gamblers and drug addicts attests to a common neurobiological process underlying these addictions and behaviours (Holden, 2001; Grant, Kushner & Kim, 2001). High rates of comorbid alcohol abuse among gamblers supports this view.

In modelling the diagnostic criteria for gambling on those specified for substance use, Lesieur and Rosenthal (1991) referred to the equivalence of the euphoric state of 'action' as comparable to the 'high' derived from cocaine or other drugs, the equivalence of increasing bets to 'tolerance', and the presence of 'withdrawal symptoms'. However, the authors did not provide any empirical data that demonstrated:

- The comparability of the gambling to drug induced 'highs'

- Failed to discuss the equivalence of gambling induced ‘highs’ with drugs exerting a depressant effect in contrast to a rush or ‘high’
- Did not provide evidence indicating that increased bet sizes were motivated by a need to maintain levels of excitement as opposed to a (counterproductive) strategy to reduce financial pressures, and
- Uncritically accepted the findings of three studies (Wray & Dickerson, 1981; Custer, 1982; Meyer, 1989) reporting withdrawal-like features.

However, we argue that the empirical evidence supporting the presence of two defining elements of gambling as an addiction, tolerance and withdrawal, is lacking. The purpose of this study therefore, is to investigate the similarities and differences in withdrawal and tolerance phenomenon in gambling with that found in alcohol dependence to determine the validity of the addictions model of gambling. The following sections will review the literature on the positive reinforcement of excitement as a reinforcer in gambling, and the evidence supporting features of withdrawal and tolerance.

Excitement as a reinforcer in gambling

Evidence from self-report and psychophysiological studies are consistent in demonstrating that gambling is associated with subjective and physical levels of arousal. The subjective arousal refers to emotional states characterised by, or labelled as, ‘euphoria’, ‘excitement’ or elevated mood/affect, and assessed by anecdotal accounts or responses to visual analogue or self-report measures. Intensity of arousal are reported to be higher among regular as compared to infrequent gamblers (Cocco, Sharpe, & Blaszczynski, 1995; Coventry & Brown, 1993), and is positively associated with boredom proneness and possibly chasing losses (Leary & Dickerson, 1985).

While both gambling and drug-related behaviours involve repetitive activities that induce a state of altered arousal characterised by subjective excitement with many gamblers describing this excitement as equivalent in intensity to the ‘high’ produced by psychoactive substances, no studies have systematically compared the similarities of the excitement generated by gambling and psychoactive substances.

The data on physiological arousal in gambling shows some trends but also some inconsistencies. In their comprehensive and detailed review of the bio-behavioural studies in gambling, Goudriaan, et al. (2004) succinctly summarised the current state of knowledge pertaining to the psychophysiology of gambling. In brief, according to Goudriaan et al., psychophysiological studies consistently show that baseline levels of heart rate responses are no different between pathological and high frequency gamblers but that the pattern of responding under certain conditions differs. For pathological and high frequency as compared to low frequency gamblers, heart rate levels increase at a non-significantly higher rate during gambling, arousal is higher when larger bets with real money are risked in in-vivo settings, with heart rates tending to fall faster immediately after cessation of gambling. Although heart rate increases are lower for females as compared to their male counterparts, no differences in heart rate responding for female high and low frequency gamblers, or for 'chasers' as compared to 'non-chasers' are found. As expected, heart rate is higher during and after play for winners than losers among female gamblers.

Comparing a range of physiological indices (SCL, EMG and HR) between problem, high frequency and low frequency gamblers, across five conditions, Sharpe, Tarrier, Schotte, & Spence (1995) found that with the exception of heart rate, problem gamblers displayed higher levels of arousal of parasympathetic arousal (SCL) than both remaining comparison groups. As expected, preferred modes of gambling (slot machines) evoked more arousal than other gambling cues (horse race video).

Sharpe's study argues against a linear progression of arousal from low to high to pathological gamblers and raises the methodological validity of equating high frequency with problem/pathological gamblers.

Diastolic and systolic blood pressure was found to increase before and during but decreasing after slot machine gaming in both a sample of dependent and non-dependent gamblers. The dependent as compared to non-dependent gamblers obtained lower diastolic blood pressure readings throughout the procedure suggesting the presence of lower basic arousal levels in this cohort of players.

Withdrawal in gambling

Under conditions of physical dependence, neuroadaptive changes occur to compensate for differential excitatory or inhibitory effects of a substance at the transmitter-receptor level. Any subsequent cessation of substance use has the potential to precipitate an array of symptoms and signs that in cumulative terms is labelled withdrawal or abstinence syndrome (Ghodse, 2002).

Several studies have attempted to explore withdrawal symptoms with gamblers. Wray and Dickerson (1981) and Meyer (1989) conducted the first of these studies with groups of male gamblers. While both studies identified primarily psychological symptoms and a few physical symptoms, small sample sizes, lack of control groups, and lack of screening for co morbid substance use and/or dependence have compromised the validity of their findings. Both studies noted that gamblers with higher levels of arousal during gambling exhibited greater withdrawal symptoms upon cessation. However, this correlation suggests merely that the higher the level of arousal, the greater the physiological reaction to withdrawal of the arousal stimulus. Such a finding is arguably generalisable to any arousal-generating activity and would signal biological and neurochemical reactivity rather than a symptom of gambling pathology.

In an attempt to rectify some of the methodological shortcomings of the earlier studies, Rosenthal and Lesieur (1992) surveyed 222 pathological gamblers and 104 substance-dependent controls, who failed to meet criteria for pathological gambling, regarding a range of withdrawal-like symptoms when attempting to stop gambling. Compared to only 2% of controls, 65% of pathological gamblers endorsed at least one symptom of withdrawal: insomnia (50%), physical weakness (27%), heart racing or palpitations (26%), shaking (19%), muscle aches or cramps (17%), difficulty breathing (13%), sweating (12%) and chills or fever (6.5%). This finding is hardly persuasive, given that a percentage of subjects only slightly higher than chance endorsed one of several criteria that could arguably be attributed to other factors such as stress. Further, such symptoms are common to conditions of anxiety and depression often found in gamblers suggesting the features are related not to withdrawal by other concurrent disorders. In addition, the researchers found that withdrawal was significantly correlated with income, though failing to record the amount of debt owed by each gambler. This

suggests that the symptoms of dysphoric mood may have actually resulted from the prospect of mounting debt in the absence of the hopeful fantasy of a big win; arguably, gamblers with greater debt and less income would report more symptoms consistent with panic over their financial situation and lack of options. The study also failed to control for medical history, prior history of similar psychological or physical symptoms, other stressors co-occurring with gambling cessation, or the level of gambling involvement of control subjects who reported no symptoms of withdrawal. If, as Jacobs (1986) asserts, pathological gamblers are psycho-biologically predisposed to a state of under- or over-arousal before acquiring the disorder, then it is logical that those premorbid predispositions would manifest when the self-soothing mechanism of choice is removed.

A more recent study provides an alternate hypothesis regarding withdrawal symptoms. In a survey of 16 problem gamblers and 16 problem drinkers, Orford, Morison, and Somers (1996) found that gambling withdrawal symptoms, far less prevalent than those associated with alcohol withdrawal, were by-products of negative feelings experienced as a result of gambling losses, shortages of money, and the need for secrecy rather than from a psychophysiological response to the absence of the gambling activity. The authors concluded that secondary processes, combined with primary incentive motivation and tertiary effects of losses associated with excessive behaviour, explain the addictive process involved in pathological gambling, effectively rendering tolerance, withdrawal and neuro-adaptation of little importance.

Phenomenology of tolerance in gambling

Few studies have investigated the tolerance in gambling. Anecdotal reports emanating on clinical population frequently contain reference to gamblers reporting the need to increase bets. However, it remains uncertain as to whether need is driven by a desire to generate equivalent levels of arousal, or represents a poor strategy to reduce mounting debts. That is, as the magnitude of debt increases, larger bets are required to in order to win sufficient amounts to reduce the debt. With continued losses, further debts accumulate requiring even larger bets with the cycle progressively deteriorating. This is not tolerance but a poor behavioural strategy to reduce financial debts.

Griffiths (1993) conducted one of the only studies to attempt an objective measurement of tolerance. Using heart rate measures of 30 adolescent male gamblers, the study tested differences between regular and non-regular fruit machine players during and after gambling. Results showed there were no differences between groups during gambling, with heart rates increasing by 22 beats per minute in each group. However, unlike non-regular gamblers, the heart beats of regular gamblers decreased significantly after gambling. Griffiths (1993) hypothesized this finding could demonstrate an objective measure of gambling tolerance. However, since gamblers were grouped on frequency of play rather than gambling severity, the study fails to account for differences within groups. Thus, decreases in arousal following gambling could be a mere artefact, or more likely, suggest that the novelty and unfamiliarity of fruit machine gambling could generate and maintain arousal levels with non-regular gamblers during and after the exercise, while habituation among regular gamblers would generate initial arousal during play before returning to normal baseline levels following the accustomed gambling activity.

The focus of interest in this project is to gain a clearer understanding of the features of cravings, withdrawal and tolerance reported in samples of pathological gamblers, to compare their similarity to other addictive disorders and to clarify the causal role of these features in relape.

Aims and objectives

The primary objective of this study was to gain a description of the phenomenology of the 'withdrawal' symptoms commonly reported by pathological gamblers following the cessation of gambling behaviour, and to obtain a clear understanding of the process of 'tolerance' associated with increasing bet size within sessions and across time. The study also examined whether withdrawal and tolerance were unique to problem gamblers or whether comparable phenomenological features were found in populations of regular social gamblers. The specific aims of the study were:

1. To assess the presence and phenomenology of cravings, withdrawal and tolerance in problem gamblers.

2. To compare the similarities between these constucts in samples of problem gamblers and substance abusers.
3. To determine the relationship between these constructs in maintaining persistence in gambling and as a trigger factor for relapse after a period of abstinence.

METHOD

Participants

All participants were drawn from clinical populations of individuals attending for treatment at either a specialist pathological gambling treatment centre or a drug and alcohol facility for alcohol dependence. To recruit participants, counsellers were requested to distribute participant information sheets to their clients. This methodology did not allow the researchers to accurately track the total number of clients actually invited to participate or the number of those declining such an invitation. Therefore, it was not possible to determine the total population pool of eligible participants or to calculate a response rate.

The total sampe size for this study was n = 63 participants (n = 39 (63%) males and n = 23 (37%) females. One respondent failed to indicate his/her gender.

Participants were allocated to one of three groups on the basis of their primary diagnosis: n = 19 pathological gamblers with no comorbid alcohol dependence; n = 25 alcohol dependent with no reported history of excessive gambling; and 19 individuals in treatment with a primary diagnosis of gambling with comorbid alcohol dependence. For purposes of simplicity in reporting results, these samples are referred to as the gambling, alcohol and comorbid groups.

The distribution of gender by group is shown in Table 1. Chi-square analysis revealed that there was no significant difference in the distribution of males and females across groups.

Table 1: Distribution of males and females across groups

	Gender		
Group	Male	Female	Total
Gambling	8	11	19
Alcohol	17	8	25
Comorbid	14	4	18
Total	39	23	62

The mean age of the gambling sample was 45.3 (SD = 14.0), and 40.9 (SD = 8.2) for the alcohol sample and 40.2 (SD = 9.9) for the comorbid sample. A Oneway Anova found no significant between group difference on the variable of age.

The mean South Oaks Gambling Screen (SOGS: Lesieur & Blume, 1987) score for the gambling sample was 13.9 (SD = 4.8) and for the comorbid sample, the mean was 11.9 (SD = 4.9). Alcohol dependent participants were excluded if they reported a history of excessive gambling. The mean SOGS score for the alcohol sample was zero.

The Alcohol Use Disorders Identification Test was used to assess level of alcohol use (Saunders, Aasland, Barbor, de la Fuente, & Grant, 1993). The mean score for the alcohol sample was 26.8 (SD = 9.7) and 28.0 (SD = 11.2) for the comorbid sample. The inclusion criteria for the gamblers included the absence of a reported history of excessive alcohol use. The mean AUDIT score for the gamblers was zero.

PROCEDURE

Participants were drawn from nine specialist gambling treatment programs and/or drug and alcohol facilities expressing support for the study. Meetings were held with a range of counsellors at several facilities including a formal seminar presentation at one centre to outline the nature and purpose of the study for purposes of recruiting counsellors to assist in gaining access to potential participants.

Initially the intention was to administer a semi-structured gambling interview to clients in person. However, because of the concern expressed by a number of counsellors

invited to participate in the study, we modified this procedure by converting the semi-structured interview into a self-report questionnaire. The main concerns centred on the unease counsellors felt about passing on contact numbers to the researcher because of confidentiality issues. The fact that participant information sheets explaining the nature and purpose of the study were given, and that consent to participate would be obtained prior to personal contact information being given to the researchers, did not reduce these counsellors' concern. To address further the confidentiality issues expressed by counsellors, we obtained approval from the Human Ethics Committee to set aside the requirement for signed consent forms on the basis that participants were able to anonymously mail completed forms through the post. We acknowledge that the potential for poor compliance and non-return of completed protocols was raised using this unavoidable procedure.

Counsellors agreeing to participate in the study were given a number of self-addressed stamped envelopes containing Participant Information Sheets and a battery of self-report questionnaires. These counsellors were requested to ask their clients if they were willing to participate in study exploring the nature of tolerance and withdrawal in gambling and if so, to give the envelope to them with instructions to mail the sealed package of completed questionnaires directly to the researchers or to the counsellor for collection. Given the poor return rate, several repeat meetings were held to encourage counsellors who had agreed to participate to distribute envelopes to clients. Despite this, a number of facilities provided a zero return rate of questionnaires.

There was a series of focus meetings with individuals to elicit qualitative data describing the role and impact of withdrawal and cravings on relapse. As an exploratory study, this phase did not advance any specific hypothesese for testing. The participants for this study were eight diagosed pathological gamblers and ten substance dependent clients seeking treatment in a private practice setting run by one of the researchers. Clients were asked to comment on aspects of their gambling or substance use related to withdrawal and tolerance and how they percieved these to influence their behaviour, particularly relapse episodes and persistence in gambling. Responses were recorded in note form. These participants described their experience of withdrawal symptoms and

the perceived role of craving and withdrawal symptoms as triggers for loss of control and episodes of relapse.

In an attempt to determine the nature of tolerance, it was intended that questionnaires would be handed out to a sample of 40 regular gamblers who would be asked to monitor gambling expenditure and provide ratings of subjective levels of arousal during play and across sessions over a period of one week to determine if there is a functional and 'dose-dependent' relationship between amount spent gambling, time and reported excitement. Initially we considered monitoring behaviours over a four month period but it became apparent that it was an unrealistic expectation for social gamblers to volunatrily cease gambling for such a protracted period of time. Accordingly, we reduced this timeframe to one week.

Questionnaires were handed out to two convenience samples of young adult basketball players and a group of school teachers. Participants were asked to maintain a daily monitoring sheet of gambling behaviour published by Dr Sharpe in which they were to record net expenditure, duration of gambling sessions and complete visual analogue ratings of subjective arousal and excitement during play. During the course of each session, participants were to monitor and rate their level of arousal/excitement and the maximum bet being played at every ten minute interval permitting a correlation of expenditure and excitement at three discrete points for every half hour play on electronic gaming machine.

In addition, we gained approval to recruit participants by through the placement of an advertisement in a large inner west registered club. The advertisement outlined the purpose of the research and called for interersted social gamblers to contact the researcher of further information.

The compliance with this phase of data collection on social gamblers proved extremely poor. There were no responses to the recruitment advertisment placed in the gaming venue and only three responses from the other two sources. The poor compliance was explained by one individual as related to several factors including low motivation and failure to remember to bring forms when gambling, deciding not to cease gambling

when exposed to a social setting where an invitation to participate socially with others presented itself, and simply putting the questionnaires aside and failing to remember to participate actively in the study.

Measures

Counsellors distributed a battery of self-report questionnaires designed to elicit symptoms of withdrawal and tolerance in addition to gambling and social demographic information to complete to potential participants.

The measures included:

1. *Semi-structured gambling interview schedule (Blaszczynski, 1998-2000)*: Participants were requested to complete this interview schedule designed to elicit comprehensive details regarding gambling behaviours, previous treatments, co-morbid conditions and family history of gambling and used extensively in a previous ethics approved treatment study funded by the Casino Community Benefit under Round 3 (Blaszczynski, 1998-2000). The interview contains items that cover all aspects of personal and family gambling demographics, history of psychological treatments received for gambling and non-gambling related conditions, suicidality, and substance use that are of clinical significance in determining the efficacy of treatment outcomes. The interview assesses changes in frequency and duration of sessions, net expenditure and perceived subjective levels of control, and urge and preoccupation to gamble. The interview contains the South Oaks Gambling Screen (Lesieur & Blume, 1987) and DSM-IV criteria for diagnosis of pathological gambling.
2. *Alcohol Use Disorders Identification Test* (AUDIT: Saunders, Aasland, Barbor, de la Fuente, & Grant, 1993): The questionnaire is a brief screening instrument for the detection of hazardous and harmful levels of alcohol consumption. The widely used 10 item self-report questionnaire provides an estimate of alcohol consumption at three levels – non-hazardous, harmful and alcohol dependence. This instrument will be used to screen out participants with alcohol related problems in the non-comorbid substance gambling sample.

3. *Severity of Alcohol Dependence Questionnaire* (Stockwell, Murphy & Hodgson, 1983): This 20-item questionnaire contains five subscales assessing physical withdrawal, affective withdrawal, withdrawal relief drinking, alcohol consumption and rapidity of reinstatement. We modified the scale items for with gambling participants by substituting gambling for alcohol and appropriately rewording items to make sense.
4. *Alcohol Use Disorders Diagnostic Schedule* This schedule was developed for use in the National Longitudinal Alcohol Epidemiology Survey by the National Institute on Alcohol Abuse and Alcoholism and was used to assess severity of alcohol use. We extracted and modified items related to tolerance and withdrawal for comparative purposes for the gamblers.
5. *South Oaks Gambling Screen* (Lesieur & Blume, 1987): The SOGS is a 20-item self-report questionnaire based on DSM-III criteria for pathological gambling. The scale has been widely used in pathological gambling research and has evidence to support its reliability and validity in clinical populations. The questionnaire is perhaps the most widely used and validated of the screening instruments used to diagnose pathological gambling and as an index of gambling severity.
6. *Withdrawal and tolerance checklist (Blaszczynski and Hill, unpublished):* For purposes of the study, we compiled a checklist of withdrawal and tolerance symptoms from those commonly described in a range of sources: clinical descriptions contained in clinical references, psychometric scales and questionnaires. We modified items to by anchoring the wording to gambling.

RESULTS

Gambling demographics

Table 2 lists the summary statistics for type of gambling and major forms of problem gambling for the gambling and comorbid samples. Some respondents did not answer all items so that where appropriate for missing data, tables will report the n of cases.

Table 2: Summary statistics for type of gambling and major forms of problem gambling for the gambling and comorbid

Variable	Group	
	Gambling N = 19	Comorbid N = 19
Type of gambling*	n (%)	n (%)
Wagering	2 (12.5)	5 (38.5)
Poker machines	15 (93.8)	11 (84.6)
Video Draw Poker	0 (0)	4 (30.8)
Keno	3 (18.8)	4 (30.8)
Casino table games	3 (18.8)	4 (30.8)
Lotteries	6 (37.5)	7 (53.8)
Sports	1 (6.3)	2 (15.4)
Day trading	0 (0)	2 (15.4)
Bingo	1 (6.3)	2 (15.4)
Main form associated with problem gambling **		
Poker machines	13 (81.3)	11 (84.6)
Wagering	2 (12.5)	2 (15.4)
Lotteries	1 (6.3)	0 (0)

* Note that respondents were able to endorse multiple forms of gambling

** Note these are mutually exclusive forms associated with problem gambling

Although gamblers endorsed participation in multiple forms of gambling, problem gambling was associated with only two primary forms. Consistent with the reported literature, poker machines represented the most prevalent form of problem gambling followed by wagering on horses. Participants did not report participating in Internet or any other additional form of gambling.

Participants in the gambling sample commenced gambling activities an average age of 16.8 years (SD = 6.7; Range = 5 to 32; 95% CI 13.0 – 20.5) as compared to the comorbid group who commenced at the non-significantly earlier age of 14.3 (SD = 2.9; range = 10 to 18; 95% 12.2 – 16.3).

Participants indicated the age at which they began gambling on the nominated form associated with problem gambling, and the age at which they estimated it became a problem. Table 3 below shows the descriptive statistics. One-way analyses of variance revealed no significant differences between the gambling and comorbid groups on these variables.

Table 3: Average age of commencement and awareness of problem gambling for gambling and comorbid participants

				95% Confidence Interval	
	Group	Mean	SD	Lower Bound	Upper Bound
Age commenced on problem gambling form	Gambling n = 16	24.9	14.4	17.2	32.5
	Comorbid n = 13	21.8	9.8	15.9	27.7
Age aware of problem gambling	Gambling = 16	28.9	13.2	21.9	36.0
	Comorbid n = 13	24.8	9.8	19.0	30.7

Data suggests that on average, there is a three to four year period of transition from recreational to acknowledged problem levels of gambling, or alternatively, that it takes this period for gamblers to come to realize and acknowledge that their gambling represents a problem for them.

Table 4 list the reasons that participants gave that contributed to their recognizing that gambling was a problem for them. As expected, for the total sample issues associated with financial, personal distress and relationship difficulties were the primary reasons given.

Table 4: Frequency of reported reasons leading to participants recognizing that gambling was a problem

Reason	Total n = 28 (%)	Gambling n = 16 (%)	Comorbid n = 12 (%)
Financial	25 (89.3)	14 (87.5)	11 (91.7)
Personal distress	22 (78.6)	13 (81.3)	9 (75.0)
Relationship	21 (75.0)	12 (75.0)	9 (75.0)
Social	13 (46.4)	6 (37.5)	7 (58.3)
Employment	12 (42.9)	8 (50.0)	4 (33.3)
Legal	9 (32.1)	6 (37.5)	3 (25.0)
Other	2 (7.1)	1 (6.3)	1 (8.3)

Excessive gambling results in accumulating debts that causes anxiety, stress and depression in individuals as they attempt to conceal financial difficulties from others and/or continue gambling in an effort to win sufficient money to extricate themselves from their predicament. Disclosure of debts and extent of gambling couple with mood and personality changes contribute to interpersonal conflicts and relationship breakdowns. Therefore, it is not surprising that finances and dysfunctional relationships feature as predominant factors in this domain.

We asked the gambling and comorbid group to indicate how long ago they had last gambled. Results showed that on average, the comorbid group ceased gambling for twice the length of time than had the gambling group. The gambling group reported a mean of 67 days (SD = 78.1; median = 26; range = 0.3 to 210) compared to the mean 123 days (SD = 132.0; median = 56.5; range = 5 to 365) for the comorbid group.

The gambling group reported a frequency of gambling of 1.4 times (SD = 1.5) per week and the comorbid group, 1.1 times (SD = 0.3) per week over the preceding twelve month period. This difference did not reach significance. With respect to duration of each session, the gambling group reported a non-significantly different mean of 2.7 hours (SD = 1.8) compared to 4.6 hours (SD = 6.5) for the comorbid group. However, only 12 and 8 participants from each group respectively provided an estimate of session

duration limiting the statistical confidence of no between-group significant differences in time spent gambling.

A 10-point visual analogue scale with anchor points set as 'not at all' to 'all the time', 'no control' to 'complete control' and 'no urge to very strong urge' rated participants' self-rated level of preoccupation, urge and degree of perceived control over their gambling behaviours. Participants gave estimates for two timeframes: last six-months and last two-weeks. Table 5 provides the summary statistics.

Table 5: Visual analogue ratings of preoccupation, self-control and urge over gambling for the gambling and comorbid groups

		Gambling n =16 Mean (SD)	Comorbid n =12 Mean (SD)	Significance
Last six months	Preoccupation	6.3 (2.7)	5.4 (3.1)	NS
	Self-control	3.9 (2.7)	5.3 (3.5)	NS
	Urge	8.0 (2.7)	5.7 (3.4)	NS
Last two weeks	Preoccupation	3.4 (2.7)	2.8 (3.0)	NS
	Self-control	7.9 (2.5)	8.5 (3.3)	NS
	Urge	4.9 (3.2)	2.8 (3.0)	NS

No between-group differences were found for any of the three items. Consistent with that expected in a treated population, ratings for preoccupation and urge to gamble showed a decrease, and perceived self-control an increase, from the six months to two weeks timeframe

Table 6 shows the proportion of participants reporting occasional or frequent Jacobs' (1986) dissociative-type features during gambling. Chi-square comparisons revealed no significant differences in the proportion of participants in each group reporting dissociative features.

Table 6: proportion of participants reporting Jacobs' (1986) dissociative features

	Gambling		Comorbid	
	Never or Rarely	Occasionally or All the time	Never or Rarely	Occasionally or All the time
Trance-like state	4	12	7	5
Feeling a different person	3	13	4	8
Experience Blackouts	12	2	8	4
Lose track of time	3	13	1	11
Feeling outside self	6	10	8	4

Tolerance

There were several items in the battery of questionnaires assessing tolerance. The gambling demographic interview contained three items assessing the concept of tolerance. One item, that is, 'have you found the need to gamble with increasing amounts on your [problem form of gambling] to achieve your desired level of excitement?' was based on the DSM-IV criterion purportedly tapping this construct.

Table 7: Proportion of participants reporting tolerance features

	Gambling		Comorbid	
	Yes n	No n	Yes n	No n
Do you need to increase bet size to generate desired levels of excitement?	12	4	7	6
Increase in bet size per session	12	4	10	3
Increase in bet size across sessions	9	7	8	3

Chi-square analyses revealed no significant between-group differences on all three measures of tolerance. However, 75% (n = 12) of the gambling and 54% (n = 7) of the comorbid group indicated that they did need to increase bet sizes to generate their

desired excitement. In addition, approximately half to three quarters of both groups also reported progressive increases in bet size within and between sessions.

To compare the similarities in the frequency of tolerance for alcohol and gambling, participants in each of these groups completed a withdrawal and tolerance checklist of items derived from the literature. Table 8 displays the frequency with which gambling, alcohol and comorbid participants endorsed tolerance features.

Table 8: Distribution of gambling, alcohol and comorbid participants endorsing tolerance features on the Withdrawal and Tolerance Checklist

	Gambling	Comorbid		Alcohol
	Gambling	Gambling	Alcohol	Alcohol
Item	n = Yes (%)	n = Yes (%)	n = Yes (%)	n = Yes (%)
Gamble/drink more to achieve same effect	10 (59%) n = 17	9 (47%) n = 19	14 (78%) n = 18	16 (70%) n = 23
Gambled/drank where same amount did not have same effect	13 (72%) n = 18	11 (58%) n = 19	17 (94%) n = 18	17 (70%) n = 24

Similar to the DSM-IV responses, 50% to 70% of gambling and comorbid participants endorsed the checklist items relating to tolerance in respect to their gambling. Compared to the alcohol group, there was no significant difference in the proportion of the gambling group participants reporting the need to increase their consumatory behaviour to achieve the same effect.

To test if there was any difference in the proportion of participants endorsing tolerance to alcohol as compared to gambling, we combined the response for gambling for the gambling and comorbid groups and alcohol for the alcohol and comorbid groups. A two by two Chi-square statistics found that there was no significant difference in the proportions of participants from each of these groups reporting that the same amount of gambling or alcohol consumed did not have the same effect as previously experienced.

These findings suggest that there is no difference in the proportion of pathological gamblers and alcohol dependent individuals reporting what appears to be tolerance to the effect of their respective consumatory activity.

Participants rated the frequency with which they experienced tolerance effects on anchor points reflecting 'never', 'sometimes', 'often' and 'always'. To carry out a two by two Chi-square test, the 'never' and 'sometimes' categories were combined as were the 'often' and 'sometimes' categories for the responses to gambling and alcohol given by the three groups. There was a significant difference between groups with fewer participants reporting that they needed to gamble more to achieve the same effect as compared to alcohol (X^2= 7.53, df = 1, p < .01).

However, while at face value it is attractive to argue that these findings support the phenomenon of tolerance in gambling, responses to items assessing the participants' lower frequency of reported tolerance experiences and the reason for increasing bets raises the possibility of alternative explanations. Approximately two thirds to three quarter of the participants in the gambling and comorbid groups, 69% (n = 9) and 72% (n = 9) respectively, reported that increases in bet size were motivated by the prospect of increasing chances of bigger wins or for hopes of changing luck rather than excitement.

This finding supports the cognitive model of gambling and the findings of Ladouceur (2003) in his comparison of erroneous perception in 15 pathological gamblers and 15 non-pathological gamblers using the thinking aloud technique. Results indicated that significantly more pathological gamblers (81%), as compared to non-pathological gamblers, elicited erroneous perceptions. During actual play, 41% of pathological gamblers but only 27% of non-pathological gamblers gave erroneous perceptions with a trend for the conviction in likelihood of winning increasing over the session for pathological but decreasing for non-pathological gamblers. He concluded that these findings had implications for chasing losses, that is, that increasing convictions based on erroneous perception that they will win contributed to the chasing of losses.

That only 21% (n = 4) and 16% (n = 3) of the gambling and comorbid participants respectively, endorsed the need to 'keep my buzz' or for 'pure excitement' argues that only a relatively small proportion of pathological gamblers experience tolerance in the meaning of the term applied in addictions. Accordingly, this study fails to provide strong support for the argument that tolerance, in the sense of neuroadaptation, is a primary feature of pathological gambling behaviour. It appears that cognitive schemas that lead to erroneous perceptions regarding the probability of winning, gamblers fallacy and luck accounts for the manifest observation and clinical reports of increased bet sizes within and across sessions. This interpretation is consistent with the notion that financial imperatives rather than excitement explains the drive to increase bet sizes, and the frequently reported clinical accounts of problem gamblers of decreasing levels of excitement within sessions.

If this finding is replicated it calls into question the concept of tolerance that DSM-IV assesses and raises the possibility of a Type I error. That is, that DSM-IV overestimates the presence of tolerance in pathological gamblers. Based on the findings of this study, DSM-IV perhaps should be more accurately interpreted as assessing cognitive belief structures that lead to increased bet sizes rather than habituation to arousal or excitement.

Withdrawal

We asked participants to respond to the DSM-IV item assessing restlessness and irritability following attempts to cease gambling. Approximately two thirds of the gambling (67%; n = 10) and comorbid (69%; n = 9) participants responded positively to this item. Chi square analyses revealed no significant between group differences on this variable.

Participants completed a checklist of items derived from the literature to assess the frequency that they endorsed the presence of withdrawal and tolerance. Table 9 displays the reported frequency of withdrawal features for the gambling, alcohol and comorbid groups. We combined the ratings of 'never' and 'sometimes', and 'often' and 'always' to produce dichotomous categories.

Table 9: Reported frequency of withdrawal symptoms for gambling, alcohol and comorbid groups

	Gambling	Alcohol	Comorbid	
	Gambling	Alcohol	Gambling	Alcohol
	Often/always n = 18	Often/always n = 23	Often/always n = 19	Often/always n = 18
Item	n (%)	n (%)	n (%)	n (%)
Heart racing	10 (55.5)	6 (27.2)	3 (15.8)	8 (44.5)
Anxiety	12 (66.6)	15 (62.5)	7 (36.8)	11 (64.7)
Sweating	8 (47.1)	7 (30.4)	3 (15.8)	9 (50.0)
Shakes	9 (53.0)	10 (41.6)	4 (21.0)	9 (50.0)
Restlessness	12 (66.6)	14 (58.4)	4 (21.0)	8 (44.5)
General discomfort	13 (72.2)	11 (45.9)	5 (26.3)	9 (50.0)
Depression	13 (72.2)	13 (54.1)	9 (47.4)	11 (64.7)
Loss of interest	11 (61.1)	10 (41.6)	5 (26.3)	10 (55.5)
Irritability/agitation	13 (72.2)	11 (45.9)	6 (31.6)	12 (66.7)
Sleep problems	10 (55.6)	15 (62.5)	5 (26.3)	11 (64.7)
Hallucinations	4 (22.2)	5 (20.8)	2 (11.2)	5 (29.4)
Seizures	1 (6.3)	1 (4.2)	1 (5.3)	2 (11.8)
Distrustful of others	11 (61.1)	8 (34.8)	4 (21.0)	7 (41.1)
Headaches	12 (66.6)	5 (20.8)	6 (31.6)	6 (33.4)
Dizziness	5 (27.8)	5 (20.8)	2 (11.2)	5 (29.4)
Nausea/vomiting	4 (22.2)	8 (34.8)	2 (11.2)	7 (38.9)
Stomach pains	8 (47.1)	5 (20.8)	1 (5.3)	4 (22.2)
Gastrointestinal	5 (27.8)	3 (37.5)	3 (15.8)	9 (50.0)

A mixed picture of symptoms across groups emerges that is difficult to interpret. There is a tendency for the gambling group to exhibit more symptoms reflecting depression, general discomfort, restlessness and agitation as compared to the alcohol group. However, this trend does not hold for the comorbid group where alcohol related symptoms appear to predominate over gambling related ones. Nevertheless, with the exception of seizures, between a fifth and three quarters of gamblers and alcohol dependent participants report the presence of at least one withdrawal symptom.

The Severity of Alcohol Dependence Questionnaire assesses five components of alcohol dependence: physical withdrawal, affective withdrawal, withdrawal relief drinking, alcohol consumption, and rapidity of reinstatement. Table 10 shows the summary statistics for the alcohol consumption scores on this measure for the alcohol and comorbid groups.

Table 10: Severity of Alcohol Dependence Questionnaire subscale scores for alcohol for the alcohol and comorbid groups

	Alcohol n = 25	Comorbid (alcohol) n = 19
	Mean (SD)	Mean (SD)
Subscale		
Physical withdrawal	3.6 (3.4)	5.2 (3.6)
Affective withdrawal	5.0 (3.5)	5.9 (3.8)
Withdrawal relief drinking	6.2 (3.8)	7.2 3.4
Alcohol consumption	6.5 (3.8)	8.0 (4.1)
Rapidity of reinstatement	5.9 (3.8)	6.2 (3.3)
Total	27.1 (14.5)	32.0 (15.4)

There were no significant differences on the Severity of Alcohol Dependence Questionnaire subscale and total scores for alcohol withdrawal between the alcohol and comorbid groups.

Table 21shows the summary statistics for the gambling scores on the modified version of this measure for the gambling and comorbid groups.

Similarly, there were no significant differences on the modified Severity of Alcohol Dependence Questionnaire subscale and total scores for gambling withdrawal between the gambling and comorbid groups.

Table 2: Modified version of the Severity of Alcohol Dependence Questionnaire subscale scores for gambling for the gambling and comorbid groups

Subscale	Gambling n = 19 Mean (SD)	Comorbid (gambling) n = 19 Mean (SD)
Physical withdrawal	3.2 (3.7)	3.4 (4.1)
Affective withdrawal	5.9 (3.7)	4.5 (4.4)
Withdrawal relief gambling	7.0 (3.4)	5.5 (3.7)
Gambling consumption	8.8 (3.8)	6.9 (3.9)
Rapidity of reinstatement	5.1 (4.4)	4.2 (3.9)
Total	29.8 (14.9)	24.0 (17.1)

We compared subscale scores for the gambling and alcohol groups to determine if there were any differences in the reported severity of gambling and alcohol withdrawal and reinstatement effects. A series of t-test comparisons found no significant differences on these scores suggesting that the severity of gambling withdrawal symptoms are comparable to those reported for alcohol. In the same manner, there was no significant difference in subscale scores for gambling and alcohol ratings within the comorbid group.

The findings of this study, therefore suggests that the severity and nature of withdrawal symptoms for pathological gambling are relatively comparable to those reported by alcohol dependent individuals. However, given the small sample size and limited poser, the strength of this finding must remain tentative and subject to further exploration.

SUMMARY

In respect to our aims, the results of the present study provides support for the presence of withdrawal symptoms as a common feature of pathological gambling, and that the phenomenological manifestations of these symmptoms are generally similar to those observed in alcohol dependence. The most frequently reported withdrawal symptoms are those that reflect affective changes and stress and include depression, general

discomfort, irritability/agitation, restlessness, anxiety and headaches. The severity of physical and affective withdrawal as assessed by the Severity of Alcohol (and a modified version for gambling) Dependence Questionnaire appears to be no difference for gambling and alcohol. Accordingly, these findings are important in respect to cravings and relapse factors. The negative reinforcement model in the domain of substance dependence proposes that the desire to avoid or reduce aversive states of physical and psychological withdrawal are primary factors that lead to persistence in, and reinstatement of, addictive behaviours. That there is no reported difference between alcohol dependent and gambling participants on withdrawal relief drinking, presence of withdrawal symptoms and rapidity of reinstatement supports the argument that withdrawal is an important factor contributing to cravings, relapse and persistence in gambling.

With respect to tolerance, the results do not support the addictions model of gambling. While gamblers reported increases in bet size within and between gambling sessions, the majority reported motivations that were more consistent with a cognitive interpretation of gambling. Three quarters of the pathological gamblers reported that the erroneous perceptions pertaining to the gambler's fallacy and luck accounted for their reason to increase bet sizes, not the desire to generate desired levels of arousal or excitement. This finding is inconsistent with that predicted by the addiction model, that is, that neuroadaptation occurs resulting in habituation or a desensitisation to the excitement produced by gambling. In contrast, it concurs with the cognitive model in which accumulating debts coupled with erroneous perceptions leads the gambler to increase bet sized in the mistaken belief that their chances of winning over time increase (gambler's fallacy), and that larger bets are required in order to win sufficient money to meet financial obligations.

These results have implications for the conceptualisation of gambling as an addictive disorder and the relevance of aversive states of physical and affective withdrawal maintining persistence in gambling and in precipitation relapse episodes. The lack of clear evidence of neuroadaptation changes consistent with tolerance coupled with the reported motivation to increase bet sized provide greater support for Ladoceur and

Walker's (1992) cognitive, and Sharpe's (2002) biopsychosocial models of pathological gambling rather than an addictive model.

Consistent with the literature, gamblers who cease gambling experience withdrawal symptoms comparable to those reported by substance dependent individuals. Treatment interventions should address this issue by focussing on teaching cognitive-behavioural skills to allow pathological gamblers manage more effectively aversive states of physical arousal experienced as cravings, and distrubed mood states characterised by depression and stress.

APPENDIX 1

DSM criteria for substance abuse and pathological gambling

Criteria for substance abuse:	Criteria for pathological gambling
A maladaptive pattern of substance use, leading to clinically significant impairment or distress, as manifested by three (or more of) of the following, occuring at any time in the same 12-month period:	A. Persistent and recurrent maladaptive gambling behaviour as indicted by five (or more) of the following:
(1) tolerance, as defined by either of the following: a. a need for markedly increased amounts of the substance to achieve intoxication or desired effect b. markedly diminsied effect with contined use of the same amount fo the substance (2) withdrawal, as manifested by either of the following: a. a characteristic withdrawal syndrome for the substance (refer to Criteria A and B of the criteria sets for Withdrawal from the specific substances) b. the same (or a closely related) substance is taken to relieve or avoid withdrawal symsptoms	(2) a need to gamble with increasing amounts of money to achieve the desired excitement (4) is restless or irritable when attempting to cut down or stop gambling
(3) the substances is often taken in larger amounts or over a longer period than was intended	
(4) there is a persistent desire or unsuccessful efforts to cut down or control substance use	(3) has repeated unsuccessful efforts to control, cutback or stop gambling
(5) a great deal of time is spent in activities necessary to obtain the substance, use the substance, or recover from its effects	(1) is preoccupied with gambling (i.e., preoccupied with reliving past gambling experiences, handicapping or planning the next venture, or thinking of wasy to get money with which to gamble)
(6) important social, occupational, or recreational activities are given up or reduced because of substance use	(9) has jeoparidized or lost a significant relationship, job, or educational or career opportunity because of gambling

(7) the substance is continued despite knowledge of having a persistent or recurrent physical or psychological problem that is likely have been caused or exacerbated by the substance	(7) lies to family members, therapist, or others to conceal the extent of involvement with gambling
	(6) after losing money gambling, often returns another day to get even ('chasing' one's losses)
	(8) has committed illegal acts such as forgery, fraud, theft or embezzlement to finance gambling
	(5) gambles as a way of escaping from problems or relieving a dysphoric mood (e.g., feelings of helplessness, guilt, anxiety, depression)
	(10) relies on others to provide money to relieve a deperate financial situation caused by gambling

REFERENCES

American Psychiatry Association (1980) *Diagnostic and Statistical Manual of Mental Disorders: Third edition.* Washington: American Psychiatric Association Press.

American Psychiatry Association (1987) *Diagnostic and Statistical Manual of Mental Disorders: Third edition-revised.* Washington: American Psychiatric Association Press.

American Psychiatry Association (1994) *Diagnostic and Statistical Manual of Mental Disorders: fourth edition.* Washington: American Psychiatric Association Press.

American Psychiatry Association (2000) *Diagnostic and Statistical Manual of Mental Disorders: fourth edition – text revised.* Washington: American Psychiatric Association Press.

Baker, T.B., Piper, M.E., McCarthy, D.E., Majeskie, M.R., & Fiore, M.C. (2004) Addiction motivation reformulated: An affective processing model of negative reinforcement. *Psychological reviews, 111*, 33-51.

Blaszczynski, A. & Nower, L (2002) A pathways model of problem and pathological gambling. *Addiction, 97*, 487-499.

Bozarth, M.A. (1990) Drug addiction as a psychobiological process. In D.M. Warburton (Ed.), *Addiction Controversies*. London: Harwood Academic Publishers (pp112-113).

Bozarth, M.A. (1994) Pleasure systems in the brain. In D.M. Warburton (ed.), *Pleasure: The politics and the reality*. (Pp. 5-14). New York: John Wiley & Sons.

Cappell, H. & Le Blanc, A. E. (1981) Tolerance and physical dependence: Do hey play a role in alcohol and drug self-administration? *Recent Advances in Alcohol and Drug Problems, 6*, 159-196.

Cocco, N., Sharpe, L., & Blaszczynski, A. (1995) Differences in preferred level of arousal in two sub-groups of problem gamblers: A preliminary report. *Journal of Gambling Studies, 11*, 221-229.

Coventry, K.R. & Brown, R.L. (1993) Sensation seeking, gambling and gambling addictions. *Addiction, 89*, 541-554.

Custer, R.L. (1982) An overview of compulsive gambling . P.A. Carone, S.F. Yoles, S.N. Kiefer, and L. Krinsky (Eds) *Addictive disorders update: alcoholism, drug abuse, gambling*. New York: Human Sciences Press.

Dickerson, M. (1989). Gambling: A dependence without a drug. *International Review of Psychiatry, 1,* 157-172.

Dickerson, M., Hinchy, J., & Fabre, J. (1987) Chasing, arousal and sensation seeking in off-course gamblers. *British Journal of Addiction, 82,* 673-680.

Edwards, G., Gross, M.M., Keller, M., Moser, J., & Room, R. (1977) *Alcohol related disabilities* (Offset Publications 32). Geneva: World Health Organisation.

Ghodse, H. (2002) *Drugs and addictive behaviour: A guide to treatment*. Cambridge: Cambridge University Press.

Goldstein, R.Z. & Volkow, N.R. (2002) Drug addiction and its underlying neurobiological basis: Neuroimaging evidence for the involvement of the frontal lobe. *American Journal of Psychiatry, 159,* 1642-1652.

Goudriaan, A.E., Oosterlaan, J., de Beurs, E., & Van den Brink, W. 92004) pathological gambling: A comprehensive review of biobehavioral findings. *Neuroscience and Biobehavioral Reviews, 28,* 123-141.

Griffiths, M. (1993) Tolerance in gambling: An objective measure using the psychophysiological analysis of male fruit machine players. *Addictive Behaviors,* 18, 36-372.

Griffiths, M. (1996a) Internet 'addiction': An issue for clinical psychology. *Clinical Psychology Forum, 97,* 33-36.

Griffiths, M. (1996b) Behavioural addiction: An issue for everybody? Employee *Counselling Today: The Journal of Workplace Learning, 8(3),* 19-25.

Hershon, H.I. (1977) Alcohol withdrawal symptoms and drinking behaviour. *Journal of Studies in Alcohol, 38(5),* 953-971.

Holden, C. (2001) Behavioural addictions: Do they exist? *Science, 294,* 980-982.

Hollander, E. (1993) *Obsessive-compulsive related disorders*. New York: American Psychiatric Press.

Jacobs, D. (1988) Evidence for a common dissociative-like reaction among addicts. *Journal of Gambling Behavior, 4,* 27-37.

Jacobs, D.F. (1986) A general theory of addictions: a new theoretical model, *Journal of Gambling Behavior,* 2, 15-31.

Jacobs, D.F. (1988) Evidence for a common dissociative like reaction among addicts, *Journal of Gambling Behavior,* 4, 27-37.

Koob, G.F. & Bloom, F.E. (1998) Neuroscience of addiction. *Neuron, 21,* 467-476.

Koob, G.F. & Moal, M. (1997) Drug abuse: Hedonic homeostatic dysregulation. Science, 278, 52-58.

Korn, D. & Shaffer, H.J. (1999) Gambling and the health of the public: Adopting a public health perspective. *Journal of Gambling Studies, 15(4),* 289-365.

Ladouceur, R., Sylvain, C., Boutin, C., & Doucet, C. (2002) *Understanding and treating the pathological gamblers*. New York: John Wiley & Sons.

Leary, K. & Dickerson, M. (1985) Levels of arousal in high and low frequency gamblers. *Behavior Research and Therapy, 23,* 635-640.

Lesieur, H.R. & Blume, S. (1987) The South Oaks Gambling Screen: a new instrument for the identification of pathological gamblers, *American Journal of Psychiatry,* 144, 1184-1188.

Lesieur, H.R. & Rosenthal, R. (1991) Pathological gambling: A review of the literature (Prepared for the American Psychiatric Association Task Force on DSM-IV Committee on Disorders of Impulse Control Not Elsewhere Classified). *Journal of Gambling Studies, 7(1),* 5-41.

Meyer, G. (1989) *Gluckspieler in selbsthilfegruppen: Erste ergebnisse einer empirischen untersuchung*. Hamburg: Neuland.

Mule, S.J. (1981) *Behaviour in excess*. New York: The Free Press.

National Centre for Classification in Health (2000) *International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification.* Sydney: National Centre for Classification in Health.

National Research Council (1999) *Pathological gambling: A critical review.* Washington: National Academy Press.

Potenza, M.N., Steinberg, M.A., McClaughlin, S.D. (2001) Gender-related differences in the characteristics of problem gamblers using a gambling helpline. *American Journal of Psychiatry, 158,* 1500-1505.

Robinson, T.E. & Berridge, K.C. (1993) The neural basis of drug craving: An incentive-sensitisation theory of addiction. *BRESR,* 18, 247-229.

Rosenthal, R. & Lesieur, H. (1993) Self-reported withdrawal symptoms and pathological gambling. In W.R. Eadington & J. Cornelius (eds.), *Gambling behaviour and problem gambling*. (Pp.337-346). Reno: Institute for the Study of Gambling and Commercial Gaming.

Saunders, J., Aasland, O., Barbor, T., de la Fuentes, J., & Grant, M. (1993). Development of the alcohol use disorders identification test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption. *Addiction, 88,* 791-804

Sharpe, L. (2002) A reformulated cognitive behavioural model of problem gambling: A biopsychosocial perspective. *Clinical Psychology Review, 22,* 1-25.

Sharpe, L., Tarrier, N., Schotte, D & Spence, S. (1995) The role of autonomic arousal in problem gambling. *Addiction, 90,* 1529-1540.

Solomon, R.L. & Corbit, J.D. (1974) An opponent-process theory of motivation: Temporal dynamics of affect. *Psychological Review, 81,* 119-145.

Stockwell, T., Murphy, D., & Hodgson, R. (1983) The severity of alcohol dependence questionnaire: Its reliability and validity. *British Journal of Addiction, 78,* 145-156.

Volkow, N.D. & Fowler, J.S. (2000) Addiction, a disease of compulsion and drive: Involvement of the orbitofrontal cortex. *Cerebral Cortex, 10,* 318-325.

Walker, M. (1992) *The psychology of gambling.* Oxford: Pergamon.

World Health Organisation (1993) *WHO Expert Committee on Drug Dependence. Twenty-eighth Report*. Technical Report Series 836. Geneva: WHO.

Wray, I & Dickerson, M.G. (1981) Cessation of high frequency gambling and 'withdrawal' symptoms. *British Journal of Addiction, 76,* 401-405.