ATTENTION DEFICIT DISORDER AS A RISK FACTOR FOR PROBLEM GAMBLING IN ADOLESCENTS

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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 important research, and to the secretarial staff in the Adolescent Medicine Unit, Westmead Hospital, and Dr. Michael Kohn's private practice clinic for their gracious assistance.

In particular, the authors would like to warmly thank the Principals, teachers and administrative staff of Erskine Park High School and Sydney Boys High School and to the parents and students who agreed to participate in this study.

Ethics Declaration:

Ethics approval for this study was provided by:

- The University of Sydney Human Research Ethics Committee: HREC 02/03/51 approved 25/3/2002
- Department of Education and Training: SERAP 02.57 approved 4/04/2002
- Westmead Hospital Human Research Ethics Committee: HREC SAC2002/3/4.12 (1395) approved 3/6/2002

ABSTRACT

Epidemiological studies indicate that 1% of the adult population meet criteria for a diagnosis of pathological gambling and a further 2.1% exhibit severe problems consequent to excessive levels of gambling. The rates are much higher reaching 12.5% and 20.7% for patrons playing poker machines in registered clubs and hotels respectively. Most disconcertingly, adolescents and youth appear to be four times more likely than adults to be problem gamblers with base rates ranging between 4% and 9% (median 5%) being reported in school and community populations of adolescent and young adults.

Although there is some understanding of the impact and developmental, behavioural and psychological correlates associated with gambling in adolescents and youth, there is a need to clearly identify those specific vulnerability factors and causal influences that contribute to the onset of problem gambling among youth. What is known is that a range of demographic and psychosocial variables are consistently reported as being associated with problem gambling that include symptoms and behaviours expressive of an underlying propensity for risk-taking and impulsivity: substance misuse, delinquency, excitability, disinhibition and arousal.

Substantive evidence suggests that the construct of impulsivity is a significant factor mediating the severity of gambling behaviour and associated psychological morbidity in adults, and in predicting later problem gambling in early adolescence. The weight of evidence to date points to the notion that individuals with elevated personality and biological traits of impulsivity may be either or both at greater risk for developing impaired control and/or the extent of their gambling behaviour.

Attention deficit hyperactivity disorder (ADHD) is a neurobehavioral problem that affects 5-10% of children adolescence and pesists into adulthood in 30-50% of cases. It is one of the most common problems found in children and adolescence and is associated

with increased rates of aggression and antisocial behaviour, substance abuse, affective disturbances, bipolar illness, obsessive-compulsive disorder and deficits in learning.

Given the central feature of impulsivity in the motor, emotional, social and attentional manifestations of ADHD, it is not surprising therefore to find preliminary evidence suggestive of a strong link between ADHD and gambling problems both in adolescent and adult populations. On the basis of differential EEG responses and performance on neuro-psychometric measures of higher executive cognitive function that are similar to those found in children diagnosed with ADHD, the presence of ADHD or select features of the condition, represents a specific risk factor for problem gambling. The present study investigated the prevalence and nature of gambling in samples of adolescents and young adults with a diagnosis of ADHD compared to a non-clinical group drawn from schools. Findings indicated a relationship between ADHD and level of gambling but not an increased rate of problem gambling in the sample of ADHD participants as compared to the school sample.

Introduction

Subsequent to the introduction of casinos and the legalization and proliferation of electronic gaming devices in Australia over the last twenty years, problem gambling and its associated personal, familial, financial, social and economic harm has become a major public health issue (Korn, 2000). The Australian Productivity Commission (1999) and the American National Research Council (1999) reports collated national data that conclusively established the extensive harmful impact caused by problem gambling on a minority of community members. The consequences of problem gambling observed in those studies included depression, suicide, marital disharmony, criminal offences and social costs.

Prevalence estimates of problem and pathological gambling, predominantly focused on adult populations, have consistently found that 1% of the adult population meet diagnosis criteria for pathological gambling with a further 2.1% exhibiting severe gambling-related problems (Productivity Commission, 1999). Subject to the meaning of the term 'harm', the prevalence figure for community members experiencing some form adverse consequences is speculated to range between 6% and 15% (Banks, 2002). The rates are much higher for specific subpopulations reaching 12.5% and 20.7%, for example, among patrons playing poker machines in registered clubs and hotels respectively (Blaszczynski, Sharpe & Walker, 2001).

Prevalence of problem gambling among adolescents and youth

Most disconcertingly, surveys conducted on adolescents and youth populations across a number of international jurisdictions have consistently reported that young people are four times more likely than adults to be problem gamblers. Prevalence studies investigating problem gambling in adolescents in the United States, Canada, England and Europe have reported base rates ranging between 4.4% and 9% (median = 5%) of school student, adolescent and young adult respondents exhibiting adverse patterns of pathological or problem gambling (Derevensky & Gupta, 2000; Derevensky, Gupta, &

Winters, 2003; Jacques & Ladouceur, 2003; Winters & Anderson, 2000; Stinchfield, 2000; Shaffer & Hall, 1996). Additionally, 9.9% to 14.2% of adolescent and youth have been identified as being at risk for developing a gambling problem (Derevensky & Gupta, 2000). Risk factors identified include being male, regular drug use, parental gambling, history of delinquency, and poor academic grades (Stinchfield, 2000; Griffiths & Wood, 2000; Vitaro, Ladouceur & Tremblay, 2001).

What is of particular concern given the widespread acceptance of gambling in Australia is the relative absence of Australian data on adolescent gambling. A literature review conducted by the Victorian Department of Human Resources (1999) reveals only a handful of studies exist investigating the extent of youth gambling and problem gambling with most using a range of disparate definitions and measures that complicate possible cross-study and cross-cultural comparisons, and because of legislated age restrictions, limiting to their sample to include only subjects aged 18 or older. Nevertheless, most have found prevalence rates that are comparatively lower than comparable international studies but still in excess of those found in adults. These findings have led Delfabbro & Thrupp (2001) to suggest that the foundations for gambling appear to be laid in adolescence.

In his study, Hebron (1996) did not quantify problem gambling but found that 74% of 200 year 10 students had reportedly gambled in the previous year with 3.5% reporting daily gambling. Hunt (1998) surveyed 778 Year 12 students from a total of ten state and private, urban and rural schools in Victoria. Again, this study did not include a diagnostic measure of problem gambling but 9% were reported to be gambling on a regular basis. Jackson (1999) obtained a similar figure of 8% in his study of 2,788, Year 8 students reporting participation in three or more forms of gambling.

In one of the largest studies on Victorian youth, Moore and Ohtsuka (1997) surveyed a sample of 1,107 14 to 25 year olds using a modified 10-item version of the South Oaks Gambling Screen (SOGS) (Lesieur & Blume, 1987) and found that 14% reported having

gambled more than they intended, 30% chased losses, and 3% classified themselves as problem gamblers.

In a subsequent study investigating the structure of youth leisure and gambling, Moore and Ohtsuka (2001) administered the SOGS to 769 adolescent school children aged 15 to 18. Of the sample, approximately 4% obtained SOGS scores in the problematic range on the SOGS.

Delfrabbo and Thrupp (2001) more recently reported data derived from a South Australian sample of 505 students in years 10, 11 and 12 from six metropolitan high schools. The mean age of the sample was 16.5 years with a range of 14 to 17 years. Fisher's (2000) DSM-IV-J with a criterion threshold score of four was used to assess problem gambling. Consistent with other Australian studies, 3.5% of the sample scored within the problem gambling range with approximately 9.0% endorsing one, 4.3% endorsing two and 1.9% endorsing three criterion items. This gave a total of 18.8% scoring at least 1 on the DSM-J-R. Of interest, the level of problem gambling did not vary according to school year level.

There are however, major methodological limitations that reduce the utility, validity and reliability of the above studies. Most notable are the disparate definitions, terminology and criteria are used to define children, adolescent and youth, the inclusion of children from all phases of maturational development, absence of school drop-outs and failure to take into account differences in legal ages for, and access to, gambling. Terms such as children, school children, adolescents, youth and young adults are used frequently used with samples including subjects aged 12 to 25 (Hunt, 1999), and 10 to 21 (Australian Council of Social Services, 1997), 14 to 25 (Moore & Ohtsuka, 1997) with others including school children, for example aged 16 to 17 years (Burnett, Ong & Fuller, 1999; Hebron 1996) while excluding school leavers who are likely to be more at risk of problems.

The omission of school leavers is an important methodological weakness leading to an underestimate of prevalence rates given the consistent relationship observed between risk for gambling and learning difficulties and poor academic performance. For example, in Delfabbro and Trupp's (2001) study, the frequency of gambling fell significantly for Year 12 as compared to Year 10 and 11students. In the Australian Council of Social Services (1997) study, school dropouts and retainers differed on the likelihood of wagering on horses, which suggests that studies that exclude this population will necessarily underestimate the prevalence of gambling behaviours.

Further, taking into consideration poor school performance as a predictor of problem gambling, evidence suggests that a proportion of problem gamblers drop out of school and therefore are omitted from youth studies limited to school children resulting in an underestimate of youth problem gambling rates. Despite these limitations, the rate of adolescent pathological gambling in Australia appears to waiver around 3%, a figure lower than that reported for overseas jurisdictions but substantially higher than that found for adult populations. This figure highlights the importance of studying factors contributing to gambling and pathological gambling among youth.

Vulnerability for pathological gambling in adolescence

Although there is some understanding of the prevalence, impact (Victorian Department of Human Resources, 1999), and developmental, behavioural and psychological correlates associated with gambling in adolescents and youth (Derevensky, Gupta, & Cioppa, 1996; Stinchfield, 2000), there is a clear need to identify specific vulnerability factors for the onset of problem gambling among youth. Not least of which, because this might ultimately help to understand the cause of gambling problems.

There is no doubt a complex and varied interaction of environmental, social and intra-individual factors that leads to impaired control and the manifestation of harm in heterogeneous subgroups of gamblers. However, it is interesting to note that demographic and psychosocial variables consistently associated with adolescent problem gambling have included symptoms and behaviours that are expressive of an underlying propensity

for risk-taking and impulsivity, including substance misuse, delinquency, excitability, disinhibition and arousal (Derevensky, et al., 1996; Stinchfield, 2000). This propensity is evident in more attenuated form in behavioural conditioned and emotionally vulnerable, and maximal in biologically impulsive, pathological gambling subgroups (Blaszczynski & Nower, 2002).

Problem gambling, attention deficit disorder and impulsivity

Impulsivity is one construct common to both ADHD and pathological gambling that has received considerable research attention. DSM-IV-TR (American Psychiatric Association, 2000) describes pathological gambling as a disorder of impulse control. Impulse control deficits are manifested by an inability to cease or inhibit behaviour regardless of consequences, the tendency to act without consideration of consequences, and differential sensitivities to immediate reinforcement and punishment (Vitaro, et al., 2001; White, Moffitt, Caspi, Bartusch, Needles, & Stouthamer-Loeber, 1994).

There is substantive evidence suggesting that the construct of impulsivity is a significant factor mediating the severity of gambling behaviour and associated psychological morbidity in adults (Blaszczynski, Steel, & McConaghy, 1997; Carlton & Manowitz, 1994; McCormick, Taber, Kruedelbach, & Russo, 1987; Steel & Blaszczynski, 1998). Moreover, in the only prospective study to investigate which factors predict later problem gambling in early adolescence, impulsivity was found to be an independent predictor (Vitaro, Arseneault, & Tremblay, 1999). Comparing mean impulsivity scores of 115 adult pathological gamblers to 235 controls, Blaszczynski, Steel, and McConaghy (1997) found elevated levels of impulsivity in pathological gamblers and a high correlation between impulsivity and measures of psychopathology and clinical criteria for antisocial personality disorder within a narrow subgroup of problem gamblers. In addition, the researchers found that heightened impulsivity scores correlated with a history of suicide attempts, problem drinking, occupational instability, and frequency of gambling. In a follow-up study, Steel and Blaszczynski (1998) found that problem and pathological gamblers scored higher on measures of impulsivity and non-planning than gamblers with less pathology.

Other factor analytic studies have also confirmed the existence of an impulsive subtype of pathological gamblers (Gonzalez-Ibanez, Jimenez, & Aymami, 1999; Steel & Blaszczynski, 1996; Zimmerman, Meeland, & Krug, 1985). In these studies, gamblers were found to have elevated levels of impulsivity highly correlated with measures of psychopathology and clinical criteria for anti-social personality disorder, a family history of problem gambling, early onset, more severe levels of gambling, a history of suicidal ideation and/or attempts, co-morbid substance dependency, antisocial and narcissistic traits, affective instability, widespread dysfunction in non-gambling related areas, and unresponsiveness to treatment (Blaszczynski, Steel, & McConaghy, 1997; Steel & Blaszczynski, 1996, 1998).

Recent studies in the fields of biochemistry (Carrasco, et al., 1994; Moreno, Saiz-Ruiz, & Lopez-Ibor, 1991) and genetics (Blum et al., 1996; Comings et al., 1996) have tentatively linked receptor genes and neurotransmitter dysregulation to reward deficiency, arousal, impulsivity, ADHD, substance abuse, pathological gambling and other compulsive-type behaviours. Preliminary evidence supports the hypothesis that serotonin (mood regulation), norepinephrine (mediating arousal) and dopamine (reward regulation) may all play a role in impulsivity, mood disorders, and impaired control (Bergh, et al., 1997; DeCaria, et al, 1996; Lopez-Ibor, 1988; Moreno, Saiz-Ruiz, & Lopez-Ibor, 1991; Roy, De Jong, & Linnoila, 1989).

Genetic studies have also reported that pathological gamblers, substance abusers, and individuals with ADHD, among others, are significantly more likely than controls to possess the dopamine D2A1 allele receptor gene (Comings, et al., 1996). This genetic variant has also been found more often in individuals with impulse control disorders and has been associated with reduced D2 receptor density and deficits in dopaminergic reward pathways. Of note, 76.2% of pathological gamblers who were co-morbid alcohol abusers carried the gene compared to 49.1% of males without co-morbid alcohol abuse or dependency. It is hypothesized that a lack of D2 receptors cause individuals to experience attentional deficits and seek pleasure-generating activities, placing them at high risk for

multiple addictive, impulsive and compulsive behaviours, including substance abuse, binge eating, sex addiction, and pathological gambling (Blum, et al., 2000). Thus, the genetic research suggests that the drive toward intense and, sometimes, detrimental pleasure seeking is biologically prescribed, though the choice of behaviour differs by individual.

The weight of evidence to date, therefore, points to the notion that individuals with elevated personality and biological traits of impulsivity may be either or both at greater risk for developing impaired control over their gambling behaviour. It is possible that biologically-based trait of impulsivity may create a subset of gamblers who manifest differential responses to reward and punishment, characterized by a marked propensity to seek out rewarding activities, an inability to delay gratification, a dampened response to punishment and failure to modify behaviour because of adverse consequences. If this hypothesis proves correct, then individuals with ADHD would be at high risk for developing gambling problems on the basis that many adolescents and adults with ADHD could adopt gambling as a preferred activity because it fuels a genetic predisposition toward pleasure-seeking, provides arousal and stimulation to counter boredom, and evokes dissociative-like experiences that provide self-medication for underlying affective and/or personality disorders. It could also be argued that their predisposition toward impulse dyscontrol will soon render gambling behaviour pathological for a percentage of those youth

Attention deficit hyperactivity disorder is a neurobehavioral problem that affects 3-10% of children and adolescence, and pesists into adulthood in 30-50% of cases (Richters, Arnold, Jensen, Abikoff, Conners, Greenhill, Hechtman, Hinshaw, Pelham, & Swanson, 1995; Smalley, et al, 1998). ADHD may be detected as early as age 3 years and accounts for approximately a third to a half of all referrals to child mental health services. Accordingly, it is arguably one of the most common problems found in children and adolescence.

The disorder is characterised by developmentally inappropriate behaviours, low tolerance for frustrations, impulsivity, poor organisation, distractibility and inability to sustain attention and concentration (Richters, et al., 1995). Common comobid conditions include increased aggression, antisocial behaviour (Barkley, 1998;), substance abuse (Mannuzza, et al., 1993), affective disturbances (Biederman, et al., 1991), bipolar illness (West, et al., 1995) obsessive-compulsive disorder (Moll, et al., 2000), conduct disorder and oppositional defiant disorder (Jensen, Martin, & Cantwell, 1997) and attentional deficits in learning (Shaywitz & Shaywitz, 1991).

The clinical recognition of hyperactivity in children first appeared in1902 with the use of stimulants in treatment applied in 1937 (Goldman, Genel, Bezman, & Slanetz, 1998). Since then the terminology used to describe what is currently labelled as attention deficit hyperactivity disorder has changed over time preventing accurate comparisons between studies and over time. Reflecting the diffuse nature of the syndrome, terms such as hyperactivity and minimal brain dysfunction/damage (prior to DSM classifications), attention deficit disorder (ADD) and hyperkinetic reaction (DSM-II), attention deficit hyperactivity disorder (ADHD; DSM-III-R & DSM-IV) have been applied (Richters, et al., 1995).

Diagnostic criteria for ADHD were first described in DSM-III (American Psychiatric Association, 1980) with a shift of focus toward attentional problems and impulsivity being reflected in the later DSM-III-R revision (American Psychiatric Association, 1987), and the introduction of inattentive, hyperactive and combined sub-typing in DSM-IV (American Psychiatric Association, 1994). In part, a diagnosis is made on the basis of a set of symptoms associated with hyperactivity and impulsivity and by exclusion. That is, there is an absence of any identified pathognonomic physical or neurological condition present that could better explain the observed symptoms and behaviours.

The disorder persists into adulthood with hyperactivity diminishing more rapidly than impulsivity or inattentiveness (Goldman, et al., 1998). With respect to comorbidity, 10% to 20% of community and clinical samples exhibit mood disorders, 20% conduct and

40% oppositional behaviours. In essence, 65% to 70% of ADHD children will manifest evidence of one or more comorbid conditions in adulthood with psychiatric comorbidity and family history of ADHD remaining the strongest predictor of persistence of morbidity (Goldman, et al., 1998).

The relationship between ADHD and problem gambling in adolescents, however, remains poorly understood. Nevertheless, given the nature and extent of impulse related comorbid conditions associated with ADHD, it is reasonable to argue that individuals diagnosed with a predominantly hyperactive-impulsive type of ADHD would be at greater risk for developing problem gambling behaviours. Conceptually, hyperactive children suffer persistent problems of over-activity, poor school performance, temper tantrums, defiance, peer rejection, and discipline problems leading to school expulsions and consequent low levels of self-esteem. According to Jacobs' (1986) General Theory of Addictions, early childhood dysfunction coupled with low self-esteem in conjunction with state of hyper- and hypo-arousal set the foundation for the development of problem gambling behaviours in adolescence. Dissociation is said to play a predominant role in the maladaptive use of gambling as a coping mechanism for emotional escape.

While there are no prospective studies investigating ADHD and pathological gambling, a small number of retrospective studies have found high rates of comorbidity and neurobiological correlates that strengthen the putative link between gambling and substance use disorders in adults with ADHD symptoms (Carlton & Manowitz, 1992; Rugle & Melamed, 1993; Specker, et al., 1996).

Goldstein, Manowitz, Nora, Swartzburg and Carlton (1985), investigated differential EEG activation in pathological gambling. They argued that while psychosocial factors were of major etiological significance in developing problem gambling, this might further be influenced by biologically based predispositions. These authors compared EEG activation in eight pathological gamblers and eight controls matched with respect to education, occupation, and income. Results of their study indicated that pathological gamblers demonstrated deficits in task-appropriate hemispheric differentiation, parallel to

the results found in studies investigating EEG activation in unmedicated children diagnosed with attention deficit disorder (ADD). Goldstein et al. (1985) interpreted their findings to suggest that adult pathological gamblers potentially shared a common predispositional factor with alcoholism and that both conditions could be related to dysfunctional attention deficit mechanisms, and "…to the deficits in impulse control that characterize ADD" (p.1233). However, the use of highly selected samples of pathological gamblers weakens the strength of conclusions reached, a point readily acknowledged by the authors in stating that their conclusions were 'very tentative'.

Based on the above findings, which indicated parallel EEG deficits between recovered pathological gamblers and children with ADD, Carlton and colleagues (1987) sought to further explore this association by investigating gamblers reports of ADD-related behaviour during childhood. Fourteen male pathological gamblers and 16 male matched controls were assessed on childhood behavioural traits retrospectively. Results indicated that gamblers report higher levels of ADD-related behaviour during childhood (Carlton, et al., 1987). Carlton and Manowitz's (1992) findings were consistent with their earlier studies in a subsequent comparison of 12 pathological gamblers, 12 alcoholics and 15 controls indicating that ADD may be associated with gambling independently of other associated pathology (Carlton, et al., 1987).

In interpreting their findings, Carlton and Manowitz (1987) linked excessive gambling and alcohol consumption to a deficit in inhibitory processes possibly related to, or modulated by, serotonin dysregulation that led to deficits in abilities to 'self-limit' behaviours. Specker, Carlson and Marcotte (1995) also investigated the presence of attention deficit disorder and other impulse control disorders in a sample of 40 treatment seeking pathological gamblers and 64 controls with attention deficit disorders being seen in 20% of the former. While these results clearly indicate that the link between ADHD and pathological gambling is worthy of study, the retrospective and subjective nature of the data limit the conclusions that can be drawn.

Rugle and Melamed (1993) overcame some of the limitations associated with this study by combining both neuropsychological assessment and questionnaires measuring attention and child behaviour in a survey of 33 pathological gamblers and 33 controls, matched for age and education. The objective of the study was to determine the differences between pathological gamblers and non-addicted controls on measures of attention, particularly those that assessed executive, frontally mediated aspects of attention. The results of this study provided further support that, in accordance with hypotheses, pathological gamblers displayed greater attention deficits in the area of executive functions. Further, gambling subjects endorsed more childhood behaviours consistent with ADD than controls. Results of this study further suggest the significant relationship between pathological gambling and ADD through 1) similar neuropsychological deficits and 2) endorsement of ADD-related behaviour during childhood.

While the findings in this area are consistent in supporting a relationship between pathological gambling and ADHD, small sample sizes and retrospective designs limit the robustness of the results. Retrospective questionnaires are believed to be limited in their usefulness as self-reports may be biased by current circumstance, by faulty memory, and by a "vividness of past behaviour that has been artificially amplified by repeated family stories" (Carlton & Manowitz, 1987).

In one of the few prospective studies involving adolescents, Vitaro, Arsenault, and Tremblay (1997) measured impulsivity at age 13 and again at age 17 in a group of 754 boys. Consistent with adult research, the study found that more severe gamblers exhibited higher levels of impulsivity. Vitaro and colleagues (1998; 1999) reported further evidence from longitudinal prospective studies on a sample of 154 male adolescents that led them to conclude that impulse control deficits were predictive of problematic gambling over a 5-year period. Impulsivity measures appeared to be linked to an inability to foresee consequences and an inability to cease responding despite adverse contingencies. However, in this study whether these impulsive children met criteria for ADHD was not assessed. Surprisingly, despite the consistent literature

described above, to date, there have been no studies that have assessed the prevalence of ADHD and gambling, using stringent diagnostic criteria and well-validated measures.

The purpose of this research project was to investigate the nature and rate of problem gambling in a clinical population of patients with a diagnosis of ADHD and comparing and contrasting findings against data obtained from a clinical sample of non-ADHD adolescents and a convenience sample of school children. We investigated whether a disproportionate percentage of ADHD youth are likely to develop gambling problems over time. It was hypothesized that:

1. A higher rate of gambling behaviour will be found in participants with ADHD in comparison to a similar aged normative sample of adolescents and a sample of adolescents with other clinical disorders, but not ADHD.
2. That severity of ADHD will be correlated with intensity of gambling behaviour and severity of problem gambling.

METHOD

Participants

The study included three samples of adolescents: 72 patients clinically diagnosed with ADHD attending one of three participating medical treatment centres; an adolescent medicine unit, a children's hospital and a private practice in Sydney; 39 non-ADHD patients attending the same hospitals and clinical practice; and 100 school children drawn from two schools located in the area where the clinic sample was drawn.

Adolescent patients with comorbid diagnoses, such as depression and mild learning disabilities, were not excluded from participation in the project. All participants in the ADHD sample were diagnosed by experienced paediatricians as meeting criteria for a DSM-IV-TR diagnosis of ADHD. In addition, subjects in the three samples were administered the Conners' Parent Rating Scale to obtain quantitative information about the level of ADHD symptomatology and whether symptoms were predominantly related to hyperactivity and/or attentional deficits.

The school comparison group comprised a normative sample recruited from two high schools in Sydney. The high schools included one co-educational public school in a Western suburb of Sydney and the other an all-boys school in the Eastern suburbs of Sydney. It was decided to select schools that were located close to participating hospitals and the clinical practice from which the clinical samples were drawn. It was considered that this strategy would reduce, but not eliminate, differences in socio-economic factors between the samples. Given the limited number of schools involved, it is emphasised that this constitutes a convenience sample of subjects and therefore should not be interpreted to be representative of the general population of school students.

PROCEDURE

All adolescents and their parent/guardian were given a participant information sheet describing the nature and purpose of the study and those volunteering to participate were requested to complete a written consent form prior to involvement in the study. A series of adolescents diagnosed with ADHD or other clinical problems and attending one of the three clinical groups were invited to participate in the study. Those agreeing to provide consent (in addition to parental consent where appropriate) were assessed individually at their treatment centre, prior to their routine appointment with the paediatrician. Questionnaires and the semi-structured gambling interview were completed with the research assistant. Oral presentation of items was offered to a number of ADHD participants due to specific learning disabilities to increase the validity of self-report measures.

For the normative population, the purpose of the study was explained in class participant information sheets and consent forms were distributed to students. Students agreeing to participate were requested to obtain parental consent and to return the completed forms to the investigators through the teachers. Groups of students were formed into groups of approximately 10 students with the research assistant presenting instructions and questionnaires using overhead transparency. With a booklet of the questionnaires in front

of them, students completed their relative responses to each item. Approximately 50 minutes was allocated for each group to ensure time to complete questionnaires.

Measures

All participants were requested to complete four self-report questionnaires as well as a semi-structured interview of their gambling involvement. Measures were selected in consultation with the projected hypotheses as well as with the reliability and validity of the measures. These measures included:

1. *Conners' Adolescent Self-Rating Scale: Short Form (CASS: S)* (Conners & Wells, 2000): This measure was designed for the assessment of ADHD and related behavioural problems in adolescents 12 to 17 years (Conners, 2000). The scales come in both long and short form. The short form includes pertinent items and generally provides similar results to the longer version (Conners, 2000). On the basis of factor analysis four subscales were developed: Oppositional, cognitive problems, hyperactivity and an ADHD Index. Items included in the questionnaire are directly related to the DSM IV diagnostic criteria for ADHD (Conners, 2000).

   The CASS: S comprises 27 items and adolescents rate the occurrence of specific behaviours on a 4-point scale. Raw scores for each sub-scale are converted to standard scores (T-scores) which have a mean (50) and standard deviation (10). In general, higher T-scores (and raw scores) are associated with a greater number and/or frequency of reported problems. A T-score of 65 and above are usually taken to indicate a clinically significant problem. A guide for interpretation is presented below in Table 1.

Table 1: Interpretive guidelines for T-scores and percentiles

T-score	%ile	Guideline
70+	98+	Markedly Atypical (indicates significant problem)
66-70	95-98	Moderately Atypical (indicates significant problem)
61-65	86-94	Mildly Atypical (possible significant problem)
56-60	74-85	Slightly Atypical (borderline: should raise concern)
45-55	27-73	Average (typical score: should not raise concern)
40-44	16-26	Slightly Atypical (low scores are good: not a concern)
35-39	6-15	Mildly Atypical (low scores are good: not a concern)
30-34	2-5	Moderately Atypical (low scores are good: not a problem)
<30	<2	Markedly Atypical (low scores are good: not a concern)

The CASS: S has good psychometric properties including high internal reliability for each subscale, high test-retest reliability (Cronbach's alpha ranging from .72-.87 for subscales), and discriminant validity for each subscale when compared to ADHD and Emotional Problem groups.

2. *Beck Depression Inventory-II* (Beck, Steer & Brown, 1996): This is a 21-item self-report measure designed to assess the severity of depression in adolescents from age 12 to adulthood. This is a widely used instrument with acceptable validity and reliability.

3. *Dickman Impulsivity Inventory* (Dickman, 1990): This is a 23-item forced-choice dichotomous response (agree/disagree) self-report measure that assesses functional and dysfunctional personality traits of impulsivity. Functional impulsivity is defined as a tendency to act with relatively little forethought when such a style is optimal for the individual. The Functional Impulsivity subscale contains eleven items such as, "I would enjoy working at a job that required me to make a lot of split-second decisions". Dysfunctional impulsivity is defined as the tendency to act with less forethought than most people of equal ability when this tendency is a source of difficulty. The Dysfunctional Impulsivity subscale

contains twelve items such as, “I often say and do things without considering the consequences”. An additional 23 filler items were included to conceal from participants the nature of the scale. Claes, et al. (2000) and Dickman (2000) reported Cronbach’s alpha coefficients for the Functional and Dysfunctional subscales between 0.74 and 0.85.

4. *DSM-IV- J* (Fisher, 1992): This is a 12-item instrument with 9 scored items, patterned after the DSM-IV criteria for pathological gambling. The DSM-IV-J has been specifically designed for, and widely used, in youth gambling research and has been found to effectively discriminate pathological gambling in youth up to 21 years (Fisher, 1992; Derevensky & Gupta, 2000; Gupta & Derevensky, 1998). This was administered to the clinical samples, but not the school samples.

5. *Semi-Structured Gambling Interview Schedule* (Blaszczynski, 2002): This is a semi-structured interview scheduled designed to elicit a range of sociodemographic and gambling demographic details such as the nature, forms, frequency and intensity of life-time and current gambling. The interview included items related to family and personal history of ADHD, medication use and other co-morbid conditions. This was administered to the clinical samples, but not the school samples.

6. *Alcohol Use Disorders Identification Test* (AUDIT) (Saunders, Aasland, Barbor, de la Fuente, & Grant, 1993): The questionnaire is recommended as 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.

7. *Drug Abuse Screening Test (DAST)* (Skinner, 1982): This 28-item self-report measure was designed as a brief screening instrument to assess severity of drug misuse other than alcohol and tobacco for clinical and research purposes. The instrument has a high level of

internal consistency (alpha = .92) and construct validity with other measures of drug use (Dawe & Mattick, 1997).

RESULTS

Demographic characteristics

The summary statistics for age, school grade and sex distribution for the samples are listed in Table 2.

Age

An analyses of variance revealed a significant age difference between the three samples ($F_{(2, 207)} = 5.681$, $p = .004$) with the clinical non-ADHD sample being older than both the ADHD and school samples. The ADHD and school samples did not differ from each other.

Analyses of variance were conducted to determine if there were any separate age differences for males and females between the three groups. Results showed no significant age differences for males ($F_{(2, 132)} = 0.661$, *NS*) but for females, the clinical non-ADHD group was significantly older as compared to the remaining two groups ($F_{(2,72)} = 8.938$, $p < .001$), with no differences evident between the ADHD group and the control group.

The significant age difference for the three groups appears to be accounted for by the proportion of older female non-clinical ADHD participants included in the study.

Gender

The proportion of males in the ADHD group was significantly greater as compared to either the clinical non-ADHD group ($X^2 = 18.34$, $df = 1$, $p < .001$) or school sample ($X^2 = 14.936$, $df = 1$, $p < .001$).

Table 2: Descriptive summary statistics for ADHD, non-ADHD and school samples

Variable		Group: ADHD N = 72		Non-ADHD Clinical N = 39		School sample N = 100	
		Mean	SD	Mean	SD	Mean	SD
Age	Males	14.4	2.1	14.6	2.7	14.8	1.8
	Female	14.1	2.0	16.6	2.1	14.9	1.6
	Total	14.3	2.1	15.7	2.5	14.9	1.7
		N	(%)	N	(%)	n	(%)
Gender	Male	61	(84.7)	18	(46.2)	57	(57.0)
	Female	11	(15.3)	11	(53.8)	43	(43)
School	Grade						
	5	1	(2.0)				
	6	6	(11.8)				
	7	11	(21.6)	6	(19.4)	18	(18.0)
	8	9	(17.6)	5	(16.1)	15	(15.0)
	9	11	(21.6)	5	(16.1)	9	(9.0)
	10	4	(7.8)	4	(12.9)	29	(29.0)
	11	7	(13.7)	4	(12.9)	22	(22.0)
	12	2	(3.9)	7	(22.6)	7	(7.0)
Total		51	(100)	31	(100)	100	(100)

Family structure

Demographic details on three variables, family structure and familial history of ADHD and problem gambling, were added to the interview subsequent to the commencement of

data collection. Consequently such data was not available for the first 25 ADHD, 10 non-clinical and for one school participant. The n of cases for each of these variables is listed where appropriate in the text or tables below.

The proportion of participants residing in nuclear as compared to other family structures was determined. A nuclear family was defined as living with both biological/adoptive parents while the remainder were considered to live in other family structures. Sixty percent (*n* = 106) of all participants on whom data was available lived in a nuclear family structure while 39% (*n* = 68) reportedly lived in a family with a different structure.

The proportion of participants living in nuclear as compared to other family structures for each of the three samples is listed in Table 3.

Table 3: Frequency of participants residing in nuclear, broken or other family structures for ADHD, clinical non-ADHD and school samples

Family structure	ADHD		Clinical non-ADHD		School sample	
	n	(%)	n	(%)	n	(%)
Nuclear	26	(36.1)	18	(46.2)	62	(62)
Other	20	(27.7)	11	(28.2)	37	(37)
Other	1	(1.4)				
Missing	25	(34.8)	10	(25.6)	1	(1)
Total	72	(100)	39	(100)	100	(100)

A Chi-square analysis found no difference in the relative proportion of participants living in nuclear as compared to other family structures.

Family history, ADHD and gambling

Of the 47 participants in the ADHD group, 17 (37%) reported a positive family history of ADHD as compared to 3 (10.3%) of the 29 clinical non-ADHD and 4 (4%) of the 100

school sample participants. As expected, this difference was significant with more participants from the ADHD group reporting a familial presence of ADHD as compared to both the clinical non-ADHD (X^2 = 5.15, *df* = 1, $p < .05$) and school samples (X^2 = 25.18, *df* = 1, $p < .05$). The difference in reported rates between the non-clinical ADHD and school group was not significant (X^2 = 0.74, *df* = 1, *NS*). Four (8.9%) the 45 ADHD, three (10.3%) of the 29 clinical non-ADHD, and five (5%) of the 100 school participants endorsed a positive family history of gambling. This distribution of family history of gambling problems did not differ significantly across groups (X^2 = 1.375, *df* = 2, p = .503).

Personal psychiatric treatment history

Participants were asked to indicate if they had received any form of counselling or psychological/psychiatric treatment in addition to that for ADHD in the ADHD group. Slightly over half (54%) the total population of participants responded positively to this item. As expected, two thirds of these participants reported treatment for ADHD, while 17% (*n* = 19) reported an eating disorder, 8% (*n* = 9) depression, 6% (*n* = 7) anxiety and 5% (*n* = 6) various other disorders. Half the non-ADHD group had sought treatment for an eating disorder.

Medication

Five categories of medication/nil medication use commonly used for adolescent problems were investigated. These included: Dexamphetamine and Ritalin which are commonly prescribed medications for ADHD symptoms, Selective Serotonin Reuptake Inhibitors (SSRI) which are often prescribed for depression, a residual category labelled 'Other medication' which may have included either psychiatric or physical health medications, and nil medication. Fifty-five (76.4%) participants of the combined groups were taking medication at time of assessment; with n = 14 (25.5%) of these prescribed dexamphetamine and n = 41 (74.5%), Ritalin. Table 5 list the type of medication used by participants in each of the three groups.

Table 4 shows the number of participants in each sample treated for their respective disorders.

Medication

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Table 4: The frequency of psychiatric disorders treated in each sample

Type of Psychiatric Disorder	ADHD		Clinical non-ADHD		School sample	
	n	(%)	n	(%)	*n*	(%)
ADHD	72	(100)	0	(0)	0	(0)
Eating Disorder			19	(48.7)	1	(1)
Depression			8	(20.5)	1	(1)
Anxiety			6	(15.4)	1	(1)
Other			6	(15.4)		
Nil					99	(99)
Total	72	(100)	39	(100)	100	(100)

Table 5: Medication use by participants in each group

	Group					
	ADHD		Clinical non-ADHD		School sample	
Medication	n	(%)	n	(%)	n	(%)
Nil	14	(20.3)	19	(48.7)	99	(99)
Dexamphetamine	14	(20.3)				
Ritalin	41	(59.4)				
SSRI			17	(43.6)		
Other			3	(7.7)%	1	(1)
Total	69	(100)	39	(100)	1	(100)

Beck Depression Inventory-II

In regards to depression, all subjects (ADHD (n = 72), non-ADHD clinical (n = 39), and School (n = 100)) completed the BDI-II. A one-way ANOVA was conducted resulting in expected findings of a significant difference between groups ($F_{(2,208)} = 6.95$, $p = .001$). Post-hoc comparison results showed that both the ADHD ($M = 13.17$, $SD = 1.30$) and the non-ADHD clinical group ($M = 14.48$, $SD = 1.80$) scored significantly higher on the BDI-II than the school sample ($M = 8.63$, $SD = .83$). There were no significant statistical differences between the ADHD and non-ADHD clinical group.

AUDIT/DAST

Only the ADHD and non-ADHD clinical groups completed the AUDIT and the DAST. The reason for this was that there was some concern expressed by schools about assessing rates of alcohol consumption, in particular the appropriateness of this with underage children. The entire sample in each group: ADHD (n = 72) and non-ADHD clinical (n = 39) completed both these questionnaires. An independent t-test revealed no significant differences between the ADHD ($M = 1.86$, $SD = 4.19$) and non-ADHD clinical group ($M = 2.76$, $SD = 5.58$) on scores on the AUDIT. As for the DAST, there were no significant differences between the ADHD ($M = .90$, $SD = 3.1$) and the non-ADHD clinical group ($M = 1.64$, $SD = 3.74$). The means and standard deviations

reported above for both groups on the AUDIT and on the DAST indicate no quantifiable drug or alcohol problem amongst participants in these two groups according to each instrument's criteria.

Impulsivity

Dickman's Functional and Dysfunctional Impulsivity Scale (DFDI) (Dickman, 1990) was administered to examine differences between adaptive Functional Impulsivity (FI) and Dysfunctional Impulsivity (DI) in participants. The entire sample of participants completed the DFDI. A one-way ANOVA revealed significant differences between groups for FI ($F_{(2)} = 10.31$, $p < .001$) as well as for DI ($F_{(2)} = 11.09$, $p < .001$). As expected, post-hoc comparison analysis for FI showed that the ADHD group ($M = 4.93$, $SD = .27$) scored significantly lower than the school group ($M = 6.56$), but was not significantly different from scores in the non-ADHD clinical group ($M = 5.25$, $SD = .47$). The ADHD group scores on DI were significantly higher ($M = 7.16$, $SD = .32$) than both the non-ADHD clinical group ($M = 4.89$, $SD = .55$) and the school group ($M = 5.17$, $SD = .31$). There were no significant differences in scores between the non-ADHD clinical group and the school sample on DI.

Attention Deficit Hyperactivity Disorder

The Conners' Rating Scales-Revised (CASS: S) was used to examine self-reported differences between groups on four sub-scales: Conduct, Inattention, Hyperactivity and ADHD symptoms. Each participant in the non-ADHD clinical ($n = 39$) and school ($n = 100$) groups completed the Conner-Wells Adolescent Self-Report Scale: Short Form (CASS: S). One participant did not complete the questionnaire in the ADHD group, leaving 71 participants in this group. A multivariate ANOVA was conducted and results showed significant differences between groups on each sub-scale: Conduct ($F_{(2)} = 11.16$, $p < .001$), Inattention ($F_{(2)} = 30.94$, $p < .001$), Hyperactivity ($F_{(2)} = 15.40$, $p < .001$), and ADHD ($F_{(2)} = 22.61$, $p < .001$). Using Tukey's (HSD) Test for unplanned post-hoc comparisons with alpha set at .01, the ADHD group scored significantly higher than both the non-ADHD clinical and the school groups on all sub-scales. There were no

significant differences between the non-ADHD clinical and school group on any sub-scale. The descriptive statistics are presented below in Table 6.

Conners' rating scales: interpretation of group T-scores

According to Conners' guidelines (see Measures section) the ADHD group T-scores showed that these adolescents were 'Slightly Atypical' on sub-scales Inattention and Conduct Problems than children their own age, whereas for Hyperactivity and ADHD symptoms they scored in the average Range. For both the non-ADHD clinical group and the school sample, these adolescents' T-scores for all sub-scale, were 'Slightly Atypical' (Low scores indicate minimal to no concern) compared to their peers.

Table 6: Mean and standard deviation scores on the CASS: S sub-scales

	Group					
	ADHD		Clinical non-ADHD		School sample	
Conners' sub-scales	*M*	*SD*	*M*	*SD*	*M*	*SD*
Conduct	55.21*	9.89	49.54	5.85	49.72	7.28
Inattention	58.21*	10.84	49.87	9.43	46.53	8.75
Hyperactivity	51.73*	11.69	44.56	7.81	43.69	8.68
ADHD	54.45*	12.05	44.74	8.83	44.69	8.60

Note. * Indicates P values of 0.01

Note. Scores in table 5 indicate mean and standard deviations relative to T-scores

Diagnostic and Statistical Manual-IV-Juvenile criteria for pathological gambling

DSM-IV-J is a formal measure of problem gambling and was completed by all participants in each group: (n = 72) ADHD group, (n = 39) non-ADHD Clinical group, and (n = 100) School group. None of the three groups obtained scores in the pathological gambling range. A one-way ANOVA demonstrated no significant differences in scores on the DSM-IV-J across groups ($F_{2,208}$ =1.537, p = .217). Descriptive statistics are provided in Table 7.

Table 7: Descriptive statistics of DSM-IV-J for the clinical ADHD, non-ADHD clinical and school groups

	Descriptive Statistics		
Groups	*M*	*SD*	Range
ADHD	.19	1.10	0-9
Non-ADHD Clinical	.10	.31	0-1
School	.37	.90	0-6

Of the ADHD group, 67 (93.1%) obtained a score of zero while only 3 (4.2%) endorsed one item and 1 (1.4%) two items on the measure. Accordingly, none met criteria for pathological gambling. For the non-ADHD Clinical group, the respective figures were 39 (89.7%) for zero items and 4 (10.3%) for one item endorsed. For the School Group, 76 scored zero while 19 (19%) endorsed one item, 1 (1%) two items, 2 (2%) three items, 1 (1%) four items and 1 (1%) five items, respectively. The 2% rate for problem gambling in the school sample is consistent with that expected given the high prevalence rates of around 3% for pathological gambling within adolescent populations. The absence of pathological gamblers identified in the ADHD group does not support the hypothesis that adolescents with ADHD are at higher risk for pathological gambling.

However, as the majority of participants were taking medication, the possibility remains that such medication may be reflect a protective factor by effectively reducing levels of impulsivity. It may well be that individuals with ADHD may be exposed to greater risk of developing pathological gambling behaviours once they cease taking medication in later adolescence and early adulthood. This could explain the reported relationship between ADHD and pathological gambling in adults.

Forms and frequency

Participants were asked to report which forms of gambling that they engaged in the last twelve months. For purposes of the study, gambling was defined as risking some money or possession in the hope of winning more. Table 8 lists the proportion of participants

engaging in specific forms of gambling at least once in the last 12 months. Please note that participants may have gambled on one or more of the forms listed below, hence the data categories are not mutually exclusive.

Overall, 26 (36%) of ADHD, seven (18%) of non-ADHD and 68 (70%) of the school sample participants reported gambling in the previous twelve months. Significantly more school sample participants reported gambling behaviour compared to the ADHD (X^2 = 17.99, df = 1, p < .001) and non-ADHD clinic (X^2 = 28.52, df = 1, p < .001) samples. There was no statistical difference in the reported rates between the ADHD and non-ADHD clinic samples. The group frequency data is listed below in Table 9. Please note that each frequency category is mutually exclusive.

Table 8: Forms of gambling participation over the previous twelve months by group

	Group					
	ADHD		Clinical non-ADHD		School sample	
	n	%	n	%	n	%
Poker machines	4	(5.6)	3	(7.7)	9	(9.0)
Keno	3	(4.2)	1	(2.6)	11	(11.0)
Wagering on horses, greyhounds & trotting	1	(1.4)	2	(5.1)	23	(23.0)
Instant scratch lotteries	8	(11.1)	4	(10.3)	25	(25.0)
Lotto	1	(1.4)	1	(2.6)	9	(9.0)
Lottery	2	(2.8)	1	(2.6)	7	(7.0)
Casino table games	1	(1.4)	0	(0)	2	(2.0)
Sports	10	(13.9)	2	(5.1)	37	(37.0)
Billiards	3	(4.2)	0	(0)	6	(6.0)
Card games (non-casino)	5	(7.0)	4	(10.3)	13	(13.0)

Bingo	1	(1.4)	0	(0)	11	(11.0)
Internet	1	(1.4)	0	(0)	5	(5.0)
Video games (Gameboy, Nintendo)	3	(4.2)	0	(0)	6	(6.0)
Other	1	(1.4)	0	(0)	7	(7.0)
Total	71	(100)	39	(100)	100	(100)

Table 9: Individual gambling frequency by groups over the last year

Gambling Frequency	ADHD		Clinical non-ADHD		School sample	
	n	(%)	n	(%)	n	(%)
Not in the last year	46	(63.9)	32	(82.1)	107	(51.4)
In the last year	1	(1.4)	1	(2.6)	16	(7.7)
In the last 6 months	7	(9.7)	2	(5.1)	20	(9.6)
In the last month	7	(9.7)	2	(5.1)	25	(12)
In the last week	3	(4.2)	1	(2.6)	23	(11.1)
Two to 3 times a week	4	(5.6)	0	(0)	9	(4.3)
Daily	4	(5.6)	1	(2.6)	8	(3.8)
Total	72	(100)	39	(100)	100	(100)

With the exception of the non-ADHD Clinical sample, the majority of participants reported that they gambled exclusively on one form of gambling: 22 (85%) of the ADHD and 50 (73%) of the school sample. In contrast, three (43%) of the non-ADHD sample reported gambling in one form only but the overall sample size of seven is relatively small and therefore may be an artefact of small sample size.

Chi-square analyses were used to compare differences in the distribution of each of the forms of gambling across the three groups. Results indicated that significantly more of the school sample participated in wagering on horses, greyhound and trotting races (X^2 =

20.388, $df = 2$, $p < .001$), instant scratch lotteries, ($X^2 = 6.341$, $df = 2$, $p = .04$), sports ($X^2 = 21.326$, $df = 2$, $p < .001$) and bingo ($X^2 = 9.992$, $df = 2$, $p < .05$) as compared to the two clinic populations. There was no difference on the rates of participation in the specific forms of gambling between the ADHD and non-ADHD clinic samples.

The frequency with which participants who gambled, gambled in the last twelve months was classified into one of six categories: daily, two to three times weekly, once weekly, once per month, once every six months or once yearly.

There were four forms of gambling on which participants reported daily gambling: horses, instant scratch lotteries, casino table games and billiards. There were two reports of daily purchases of instant scratch lotteries and one of daily casino table game play by ADHD participants, one report of instant scratch lottery purchase and one of horse race wagering by non-ADHD participants, and one report of billiard play from the school sample.

In respect to gambling at least once or more weekly (excluding daily gambling), there were six reports of ADHD participants each gambling on poker machines, instant scratch lotteries, lottery and sports. There were four non-ADHD reports of gambling on poker machines, lotto, lottery and casino table games, while 34 of the school sample reported weekly or more gambling on lotto ($\underline{n} = 5$), lotteries ($\underline{n} = 2$), sports ($\underline{n} = 12$), billiards ($\underline{n} = 5$), cards ($\underline{n} = 4$), bingo ($\underline{n} = 1$), Internet ($\underline{n} = 3$) and video ($\underline{n} = 3$). The relative number per cell was too small to conduct meaningful statistical analyses.

Time and expenditure

Participants were asked how much time in minutes they gambled across an average gambling session. Of 23 participants in the ADHD group, 11 (47%) participants reported an average gambling session of up to 30 minutes in duration, while 8 (35%) gambled between 31 to 60 minutes, and just 4 (17%) gambled from 61 to 120 minutes. Of the 8 participants who reported time spent gambling in the non-ADHD Clinical group, 1 (12.5%) gambled up to 30 minutes, 5 (62.5%) gambled 31 to 60 minutes, and 2 (25%)

reported gambling from 61 to 120 minutes. Sixty-one participants in the school sample reported time spent gambling, and 36 (59%) reported gambling up to 30 minutes as an average session, while 21 (34.5%) gambled 31 to 60 minutes and 4 (6.6%) gambled from 61 to 120 minutes.

Of the 22 ADHD participants who reported gambling expenditure, 10 (49%) spent less than $10 across an average gambling session, while 9 (46%) gambled between $10 and $20, and only 1 (5%) gambled up to $100. In the non-ADHD Clinical sample, 8 participants reported expenditure, of which 3 (38%) gambled less than $10 per session, 4 (50%) gambled between $10 and $20, and 1 (12%) gambled up to $100. Sixty-four participants in the School sample reported gambling expenditure, and 36 (56%) spent less than $10, 20 (31%) gambled between $10 and $20, and 8 (13%) spent up to $100 in a typical gambling session.

Not all reported gambling involved money. Rather than spending money at a typical gambling session, some participants indicated that they bet with possessions. Three possession categories were delineated based on the details given by respondents: consumables (e.g. food such as chips, soft drinks, chocolates and lollies), inexpensive items (e.g. cards which children and adolescents often collect and swap, Tazo's, Pokemon, Sports cards, and action figures), and expensive items (e.g. Nintendo games, Gameboy games, videos). Of the three participants in the ADHD group who bet possessions in a typical gambling session 1 (33.3%) bet consumables, and 2 (66.7%) bet inexpensive items. Of the 8 non-ADHD Clinical sample, 4 (40%) bet consumables, while 3 (37.5%) bet with inexpensive items, and 1 (12.5%) bet with expensive items. Eleven participants reported betting with possessions in the School sample and 5 (45.5%) bet with consumables, while 5 (45.5%) bet inexpensive items and 1 (9.1%) bet with expensive items.

History and development

Each participant was asked their age when they commenced gambling. Twenty-one (71%) ADHD, 8 (20%) non-ADHD Clinical and 67 (67%) School sample participants

provided a response to this question. An analysis of variance was conducted to examine statistical differences between groups on gambling commencement age. Results revealed a significant difference between groups ($F_{(2,93)} = 4.16$, $p = .019$). Tukey's (HSD) test of comparisons revealed that the school sample ($M = 12.61$, $SD = 2.36$, Range = 7-18 years) gambling commencement age was significantly younger than the non-ADHD Clinical group ($M = 15.25$, $SD = 2.87$, Range = 11-18 years). There were no significant differences in gambling commencement age between the non-ADHD Clinical and ADHD (M=13.67, $SD = 3.48$, Range = 6-20 years) and groups.

Participants were asked whether or not they first started gambling with family/friends. Of the 72 ADHD, 39 non-ADHD Clinical and 100 School, participants who endorsed this question, 22 (30%) ADHD, 6 (15%) non-ADHD Clinical, and 67 (67%) School group participants reported first gambling with family/friends. Chi-square analyses revealed no significant differences between groups on whether or not they first started gambling with family/friends.

In relation to the above question, a breakdown of which participants first started gambling with family, friends, or on their own was asked to obtain an idea how early social experiences influenced their gambling experience. Nineteen of the ADHD sample responded positively to this question; seven (37%) first started gambling with friends, while nine (47%) started gambling with family members and three (16%) indicated gambling with both friends and family. For the eight participants in the non-ADHD Clinical group reporting on this question, three (38%) indicated first gambling with friends, four (50%) with family, and one (12%) gambled with both friends and family. For the School sample of 67, 22 (33%) began gambling with friends, 35 (52%) with family, four (6%) with both family and friends, and five (8%) indicated first gambling on their own. Chi-square analyses showed no significant difference between groups on family member or friend categories.

Participants who indicated first gambling with family members were asked which family members they first gambled with, with response categories including mother, father,

brother, sister, a combination of those family members, and a residual other category (which may have included Aunts, Uncles and Cousins). It appears that there are a greater number of participants being influence by parents' involvement in gambling as oppose to siblings, others or a combination of family members. The results are presented below in Table 10.

Table 10: Family members involved in the first stage of gambling in the ADHD, non-ADHD clinical and school groups

Family Members	ADHD	Clinical non-ADHD	School sample
	N	n	n
Mother	1	3	12
Father	2	1	15
Brother	0	1	5
Sister	1	0	1
Combination of Member	1	0	10
Other	3	0	1
Total	8	5	44

In terms of gambling form, participants were asked which type of gambling form they first commenced gambling. Table 11 below lists the gambling forms first started by group members.

Participants were asked a question relating to the age they began gambling on commercial forms such as the pokies and casino games. The age varied for the six participants in the ADHD group (Range = 15-20) who endorsed this question. For the three non-ADHD Clinical sample participants, the commencement age of commercial gambling forms was 18 years, and of the 17 participants in the School sample age varied (Range = 12-18 years) from a much younger starting point than for the other two groups.

Table 11: Gambling forms first played by participants in the ADHD, non-ADHD clinical and school samples

	Group					
	ADHD		Clinical non-ADHD		School sample	
	n	%	n	%	n	%
Poker machines	3	(16.7)	1	(5.6)	4	(6.6)
Keno	1	(12.5)	1	(12.5)	4	(6.6)
Wagering on horses, greyhounds & trotting	0		1	(12.5)	14	(23)
Instant scratch lotteries	6	(33.3)	4	(50)	14	(23)
Lotto	0		0		2	(3.3)
Lottery	0		0		0	
Casino table games	1	(5.6)	0		0	
Sports	2	(11.1)	1	(12.5)	15	(24.6)
Billiards	0		0		1	(1.6)
Card games (non-casino)	3	(16.7)	1	(12.5)	5	(8.2)
Bingo	0		0		0	
Internet	0		0		0	
Video games (Gameboy, Nintendo)	2	(11.1)	0		3	(3.4)
Other	0		0		1	(1.1)
Total	18	100	8	100	61	100

Gambling for fun or money

It was of interest to ask participants a question regarding what motivated their first experience to gamble as well as what is motivating their interest to gamble presently. Firstly, participants were asked when they first started gambling was it for Fun, Money or

Both (Money & Fun)? Secondly, participants were asked their reason for gambling at the time of assessment (Fun, Money, Both). Chi-square analyses were used to compare differences in the distribution of each of the forms of gambling across the three groups. Results indicated significant differences categories (fun, money, or fun & money) between groups in relation to participant initial interest in gambling (X^2 = 10.51, df = 4, p = .03) and reasons for gambling presently (X^2 = 19.75, df = 6, p = .003). The results of these questions are presented below in Table 12.

Table 12: Reasons for gambling initially and now across groups

Motivation for first gambling and gambling now	ADHD n (%)	Clinical non-ADHD n (%)	School sample n (%)
First for Fun	17 (73.9)	3 (37.5)	37 (55.2)
First for Money	2 (8.7)	2 (25)	2 (3)
First for Fun & Money	4 (17.4)	3 (37.5)	28 (41.8)
Total	23 (100)	8 (100)	67 (100)
Now for Fun	16 (76.2)	2 (28.6)	31 (46.3)
Now for Money	1 (4.8)	1(14.3)	5 (7.5)
Now for Fun & Money	4 (19)	3 (42.9)	31 (46.3)
Total	21 (100)	7 (100)	67 (100)

Money and possessions won

Of interest to the study was how much and which participants had won over their gambling experience to date. One question asked about the largest amount of money or largest possession won gambling, and another question asked at what age did you win that largest amount of money or possession. One-way analysis of variance revealed no significant differences in amount of money won between groups and descriptive statistics are presented below in Table 10. However, this finding may an artefact of the small sample size and the small variance found in the non-ADHD group. At face value, it does

appear that there is a difference in amount won but further empirical data is required before being able to state this with confidence.

Table 13: Descriptive statistics of amount of money won gambling across groups

	Descriptive Statistics		
Groups	*M*	*SD*	*Range*
ADHD (n = 21)	64.56	130.13	.25 - 500
Non-ADHD Clinical (n = 7)	29.85	23.36	1 - 64
School (n = 63)	96.80	379.36	.1 - 3000

Note. *Range* varies in Cents and Dollars (i.e. .25 = 25c)

Three possession categories were delineated based on the details given by respondents: consumables (e.g. food such as chips, soft drinks, chocolates and lollies), inexpensive items (e.g. cards which children and adolescents often collect and swap, Tazo's, Pokemon, Sports cards, and action figures), and expensive items (e.g. Nintendo games, Gameboy games, videos). Three ADHD, six of the non-ADHD Clinical and nine of the School group participants responded to a question relating to the largest possession won gambling. In the ADHD group, those three participants' largest win was in the small possession category. One participant in non-ADHD Clinical group's largest possession won was consumables, three had won small possessions and two had won large possessions. For the School group, one participant won consumables, six had won small and two had won large possessions. Chi-square analysis showed no significant differences in type of possessions won across groups.

Participants reported on the age they were when they won the largest possession or amount of money gambling. A one-way ANOVA revealed no significant differences between age participants won the largest possession or money. The descriptive statistics for each group were as follows: ADHD group (*M* = 14.04, *SD* = 3.03, Range = 9-20),

non-ADHD Clinical group (*M* = 15.87, *SD* = 3.22, Range = 11-20), and School group (*M* = 13.82, *SD* = 2.03, Range = 10-18).

Urges and self-control

Participants were asked questions relating to urges to gamble, a sense of control over their gambling and how much participants thought about gambling over the last 6 months. Responses to these questions varied on a Likert type scale and included: Never, Rarely, Sometimes, Often to Always. Chi-square analysis results examining differences in responses to urges, a sense of control over gambling and how much participants thought about gambling over the last six months were not significant and descriptive statistics are shown below in Table 14.

Table 14: The frequency of urges, sense of control, and gambling thoughts across groups

	Never n (%)	Rarely n (%)	Sometimes n (%)	Often n (%)	Always *n* (%)	Total n (%)
Urges to Gamble (the last 6 mths)						
ADHD	19 (86.4)	1 (4.5)	2 (9.1)	0 (0)	0 (0)	22 (100)
Non-ADHD	5 (62.5)	2 (25)	1 (12.5)	0 (0)	0 (0)	8 (100)
School	43 (63.2)	18 (26.5)	3 (4.4)	2 (2.9)	2 (2)	68 (100)
Control Over Gambling (last 6 mths)						
ADHD	0 (0)	1 (4.5)	0 (0)	0 (0)	21 (95.5)	22 (100)
Non-ADHD	1 (12.5)	0 (0)	0 (0)	1 (12.5)	6 (75)	8 (100)
School	7 (10.4)	2 (3.0)	1 (1.5)	5 (7.5)	52 (77.6)	67 (100)
Gambling thoughts (last 6 mths)						
ADHD	17 (77.3)	4 (18.2)	1 (4.5)	0 (0)	0 (0)	22 (100)
Non-ADHD	4 (50)	3 (37.5)	1 (12.5)	0 (0)	0 (0)	8 (100)
School	62 (63.9)	29 (29.9)	5 (5.2)	1 (1)	0 (0)	67 (100)

Video involvement

It was of interest to understand whether or not video game involvement contributed to gambling involvement. Participants were asked a number of questions such as (1) whether or not they played video games such as Nintendo, Playstation, X-Box, SEGA, Game Boy or alike prior to gambling involvement, (2) what type of games they played (combat, adventure, strategy, sports, other) prior to gambling, and types they played at the time of assessment, (3) how old they were when they started playing those games, (4) how often they play video games at the time of assessment, (5) whether or not playing video games contributed to their gambling involvement and, if responding positively, (6) what way did they think playing these games may have contributed to gambling.

(1) Whether or not participants played video games prior to their gambling involvement. Participant responses to these questions varied on a Likert type scale and included: Never, Rarely, Sometimes, Often to Always. Chi-square analysis revealed no significant difference between groups and descriptive statistics are shown below in Table 12.

Table 15: Descriptive statistics of video game involvement prior to gambling across groups

	Never	Rarely	Sometimes	Often	Always	Total
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Video Games Involvement Prior to Gambling						
ADHD	1 (4.3)	2 (8.7)	9 (39.1)	4 (17.4)	7 (30.4)	23 (100)
Non-ADHD	0 (0)	1 (12.5)	1 (12.5)	5 (62.5)	1 (12.5)	8 (100)
School	4 (5.8)	12 (17.4)	15 (21.7)	23 (33.3)	15 (21.7)	69 (100)

(2) Chi-square analysis examining differences between groups in type of games participants played prior to gambling (combat, adventure, strategy, sports, other) was significant ($X^2 = 15.62$, $df = 8$, $p = .048$), however, there were no significant differences between group in type of video games played presently. Descriptive statistics are presented below in Table 16.

Table 16: Descriptive statistics of type of video games played prior to gambling and at time of assessment across groups

	Types of Video Games					
	Combat	Adventure	Strategy	Sports	Other	
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Types of Video Games Played Prior to Gambling						
ADHD	6 (10.3)	14 (42.1)	7 (12.1)	25 (43.1)	6 (10.3)	58 (100)
Non-ADHD	2 (14.3)	9 (64.3)	2 (14.3)	1 (7.1)	0 (0)	14 (100)
School	10 (11)	37 (40.7)	16 (17.6)	24 (26.4)	4 (4.4)	91 (100)
Types of Video Games Played at Assessment						
ADHD	10 (16.7)	9 (15)	12 (20)	26 (43.3)	3 (5)	22 (100)
Non-ADHD	1 (7.7)	5 (38.5)	4 (30.8)	3 (23.1)	0 (0)	8 (100)
School	13 (14.3)	30 (33)	17 (18.7)	27 (29.7)	4 (4.4)	67 (100)

(3) What age did participants begin video game involvement was analysed using one-way ANOVA and results showed no significant difference between groups. Descriptive statistics were as follows: ADHD group (M = 8.03, SD = 2.9, Range = 3-15 years), non-ADHD Clinical group (M = 8.53, SD = 2.42, Range = 5-14 years), and School group (M = 7.47, SD = 2.63, Range = 2-15 years).

(4) How often participants play video games at the time of assessment was examined using Chi-square analysis. Results revealed a significant difference between groups on how often the play video games at the time of assessment (X^2 = 21.54, df = 10, p = .018). Descriptive statistics are presented below in Table 12.

Table 17: Descriptive statistics of video game involvement at time of assessment across groups

	Daily	2-3 / week	1 / week	1 / month	1 / 6 months	1 / year	Total
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Video Games Involvement Prior to Gambling							
ADHD	27 (43.5)	17 (27.4)	11 (17.7)	6 (9.7)	1 (1.6)	0 (0)	62 (100)
Non-ADHD	3 (23.1)	4 (30.8)	3 (23.1)	2 (15.4)	0 (0)	1 (7.7)	13 (100)
School	45 (27.1)	25 (27.5)	20 (22)	15 (16.5)	9 (9.9)	7 (7.7)	91 (100)

(5) Of the 67 School group participants 64 (96%) did not believe that video game playing contributed to their participation in gambling. For the eight non-ADHD Clinical group, seven (87.5%), and all of the 21 participants in the ADHD group did not believe video game playing contributed to their participation in gambling. There were no significant differences between groups on whether or not video game playing contributed to gambling involvement across groups using Chi-square analysis.

Substance use

The AUDIT is used to measure problem drinking behaviour and the DAST is a measure of drug misuse. Both measures were used to address hypothesis 2, however, only the two clinical groups completed the questionnaire. The school sample did not complete the questionnaire due to an Ethical consideration of the DEET Ethical Committee. A t-test examining differences between the ADHD and non-ADHD Clinical groups was conducted for both the AUDIT and DAST scores and results revealed no significant differences in groups on both the AUDIT and the DAST. Descriptive statistics are presented below in Table 18.

Table 18: Descriptive statistics on the AUDIT and DAST for the ADHD and non-ADHD clinical groups

Substance Use Measures	Group Descriptive Statistics *ADHD* *M (SD)*	*Non-ADHD Clinical* *M (SD)*
AUDIT	1.86 (4.19)	2.77 (5.58)
DAST	.90 (3.1)	1.64 (3.75)
Total n	72	39

SUMMARY

To test he specific hypothesis that a high rate of involvement in gambling behaviour will be found in participants with ADHD compared to age-matched comparison control samples, item four (how often a participant gambled on their chosen gambling forms) of the Semi-structured Gambling Interview was recoded into a High and Low gambling frequency variable. Low frequency included those participants up who had not gambled in the last year, gambled once in the last year or once in the last 6 months. High frequency gambling was made up of those who endorsed gambling at least once in the last month, once in the last weeks, two-to-three times a week and those who gamble daily. The data was coded 1 for low frequency and 2 for high frequency gambling behaviour. All participants in each group completed this question in the study, except 3 from the school sample: (n = 72) ADHD, (n = 39) non-ADHD Clinical, and (n = 97) School group participants. The data was examined using Chi-square analysis and there was a significant difference between groups on categories of high and low frequency gambling behaviour (X^2 = 17.03, *df* = 2, *p* = .000). Descriptive statistics are shown below in Table 19.

Table 19: Frequency of gambling for the three groups

Gambling frequency	ADHD n (%)	Clinical non-ADHD n (%)	School sample n (%)	Total n (%)
Low frequency	54 (37.8)	35 (24.5)	54 (37.8)	143 (100)
High frequency	18 (27.7)	4 (6.2)	43 (66.2)	65 (100)
Total n (%)	72 (34.6)	39 (18.8)	97 (46.6)	208 (100)

Contrary to expectations and failing to support the hypothesis, higher rates of gambling were observed among the comparison school group in contrast to the ADHD and non-ADHD groups. Only a quarter of the ADHD group gambled within the last six months as compared to two thirds of the school group. One possible explanation is that a proportion of the ADHD participants were being managed with medication that effectively controlled their impulsivity and acted as a protective factor against loss of control. Follow-up of these individuals over the next five years into adulthood would provide informative data on the course gambling behaviour. Of particular importance would be to track their gambling behaviour following cessation of anti-ADHD medication. It is underscored that a proportion of the ADHD participants provided consent to be contacted for a follow-up in five years.

To test the hypothesis that severity of ADHD is correlated with intensity of gambling behaviour and severity of problem gambling, the ADHD sub-scale from Conners-Wells Adolescent Self-Report Scale: Short Form (CASS: S) was correlated with the frequency of gambling behaviour variable and the DSM-IV-J measure of problem gambling. Results indicated that frequency of gambling was significantly correlated with problem gambling in the ADHD group (r = .346, p = .003) and the non-ADHD Clinical group (r = .696, p = .001). There were no significant correlations among variable in the School group. However, when we combined the data for the three groups, there were no significant correlations linking the ADHD sub-scale to gambling frequency or problem gambling.

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