Are Adults with ADHD at Risk for Problem Gambling in a Lifetime?

The Role of Neuropsychological and Psychosocial Functioning

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By

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Abstract

The present study examined problem gambling, and neuropsychological/psychosocial functioning in 30 adults with ADHD compared to 28 controls. As predicted, the ADHD group had higher rates of *some problems with gambling* (46.2%) and *probable pathological gambling* (11.5%) plus was more likely to report feeling guilty about the way they have gambled (23.1%), and that they have ever felt they had a problem with gambling (15.4%). The ADHD group was also more motivated to gamble to relieve tension/help relax, and endorsed cognitions of being unable to stop gambling; they had gambled in the casino more in a lifetime and less on the lotteries compared to the control group. Within the ADHD group those with *some problems with gambling* had gambled on more activities, were less impaired on the Wisconsin Card sorting test (WCST), had less social support and lower levels of observer reports of hyperactive/impulsive symptoms, as compared to those with *no problems with gambling*. The ADHD group (N = 30) had slower and more variable reaction times, higher confidence index on the Continuous Performance Test (CPT), and slower reaction times to sad faces on the Emotional Go-No/Go compared to the control group (N = 28). Increases in observer reports of hyperactive/impulsive symptoms were related to poorer decision-making and significantly faster reaction times to sad faces. The full ADHD group also had greater levels of recent stress, anxiety and depression. These findings suggest ADHD is heterogeneous, and therefore so is risk for problem gambling; however, increases in hyperactive/impulsive symptoms, in combination with low social support, may be the recipe for developing problems with gambling in individuals with ADHD.

Introduction

Conceptualisation of Pathological/Problem Gambling

The term 'Pathological Gambling' is defined as a 'persistent and recurrent maladaptive gambling behavior'(APA, 2000) and is characterised by ten symptoms, five of which must be met to receive this diagnosis. Diagnostic criteria of pathological gambling can include the following: having a preoccupation with gambling, a need to gamble more money, being unable to stop gambling, using gambling as a way to escape problems, trying to conceal the gambling problem from significant others, committing illegal acts to finance gambling, interference of significant relationships, career or education because of gambling, and relying on others to provide money to relieve desperate financial situations caused by gambling (APA, 2000).

The diagnosis of Pathological gambling was incorporated in the DSM-III in 1980, categorised under the broad title of 'impulse-control disorders'. Concurrently with the addition of pathological gambling to the DSM-III, the frequency and forms of gambling became more prevalent in New Zealand (Abbott, 2001). The rate of gambling and frequency of venues and slot machines has continued to increase in New Zealand in the past decade. For example, in January 1991 there were 6,000 licensed non-casino gaming machines in New Zealand and this increased to 19,000 by June 2001 (Abbott, 2001).

The development of gambling venues has also influenced the tourism industry, technology and provided employment opportunities in New Zealand (Statistics, 1999). However, although an increase in gambling has provided opportunities, it has exposed society to another addictive activity that can have detrimental consequences to individuals and their families. In a 1991 New Zealand National Survey, rates of lifetime probable pathological gambling was estimated at 2.7%, and rates of current pathological gambling at 1.2% (Abbott

& Volberg, 1996). Similar rates were reported in the 2002/02 New Zealand Health Survey, with 1.2% of the full sample (12, 949) meeting current criteria for problem gambling, and 1.9% being either at-risk or having problem gambling (Mason, 2006). Therefore, prevalence rates of problem/pathological gambling in the general population tend to resemble each other; however, definitions and criteria for conceptualising gambling problems do vary within research.

Gambling problems have been defined and labeled differently across research, such as ‘problem gambling’, ‘probable problematic gambling’ and ‘pathological gambling’. In fact, these labels are often derived from the main screening instrument for problem gambling, the South Oaks Gambling Screen (SOGS). This instrument tallies a total score based on the problematic gambling behavior endorsed in a lifetime. Those individuals who obtain scores greater than 5 are classified as ‘probable pathological gamblers’, and those below this criteria are classified as having ‘some problems with gambling’ (Lesieur & Blume, 1987). Others have conceptualised a score of three and above on the SOGS as representing pathological/problematic gambling, and scores below three as characterising ‘non-problem’ gamblers (Clarke, 2004). Similarly, Lightsey and Hulsey (2002) categorised scores of 3-4 on the SOGS as ‘potential pathological gamblers’ and five and above as ‘pathological gamblers’. Although individuals who present with problems with gambling have been conceptualised differently across research, it is clear increases in scores on the SOGS universally represent more severe gambling problems.

Currently there is a consensus that gambling problems, which are often categorised in research are different in degree, rather than kind which can escalate from social, problematic to pathological gambling (Rodriguez-Jimenez et al., 2006). Blaszczynski and McConaghy (1989) argued the dimensional approach considers the interaction of the vulnerability within an individual, and the environment they have access to which may determine the severity of

gambling problems they develop. It may be when different risk factors align, the more vulnerable an individual is to developing severe problems with gambling.

Rates of Gambling and At Risk Populations

In general, research has found a high frequency of New Zealanders partake in some form of gambling in a lifetime. For example, in the 1991 national survey, 95% of respondents reported ever gambling on an activity (Abbott & Volberg, 1996), which was similar to a national survey in 1999 where 94% reported ever gambling (Abbott & Volberg, 2000). More recently, Abbott, Volberg and Ronnberg (2004) found in a New Zealand national survey of gambling 86% of individuals reported they had gambled at least once in the previous 6-months, and 41% on a weekly basis. This may also reflect the accessibility of gambling venues that individuals in the general population have access to.

In addition, those who gamble frequently have been found to range between the ages of 55-64 years (Abbott & Volberg, 2000), and in other studies between 45-65 years in both Swedish and New Zealand samples (Abbott et al., 2004). In contrast, individuals who are at risk of developing problem gambling ranged between 25-34 years in the 1999 national survey (Abbott & Volberg, 2000). Similarly, Paton-Simpson, Gruys, and Hannifin (2002) discovered the most prevalent age group presenting to telephone helplines for gambling problems have been between 20-44 years of age. Therefore, an at-risk subgroup may be individuals within a younger age bracket.

Specific ethnic groups have also been found to have higher lifetime rates of problem gambling. For example, lifetime prevalence of problem gambling has been reported to be higher in Maori (7%) and Pacific Islanders (11%), compared to New Zealand Europeans (3.4%) (Abbott et al., 2004). In addition, Asian and Maori ethnicities have been found to endorse higher scores on the South Oaks Gambling Screen (SOGS) when they initially

presented for personal counselling for gambling, compared to New Zealand Europeans (Paton-Simpson et al., 2002).

While research has continued to identify individuals who may be vulnerable to problem gambling, such as particular ethnic and age groups, researchers are also beginning to explore other at-risk groups that may be vulnerable to problem gambling, with the desire to aid in successful treatment outcomes. For example, researchers have explored a subset of pathological gamblers who report retrospective symptoms of ADHD in their childhood (Rodriguez-Jimenez et al., 2006), which may provide clues of another pathway to problem gambling that has not yet been fully investigated. Researchers are also exploring more broadly what motivates individuals to gamble, and other factors that may influence an individual to engage in gambling activities more regularly and develop problems with gambling.

Motivations for Gambling

Individuals in the general population gamble at different rates, on different forms of gambling for diverse reasons. There have been groups proposed to be 'at risk' for gambling, however, research has also explored reasons why individuals may be drawn to gambling.

Problem gamblers have found to differ in their motivations for gambling, compared to non-problem gamblers. In fact, Chantal, Vallerand and Vallieres (1994) developed a scale to measure both the internal and external motivators for gambling. They outlined internal motivations for gambling such as for *accomplishment*, to gain *knowledge* or due to the *stimulation/excitement* gambling provides. External motivations for gambling they outlined included for *external regulation* (e.g. rewards/money), *introjected regulation* (e.g. to relieve tension and guilt) and *identified regulation* (e.g. to appear important to others). Lastly, the

scale measures *amotivation,* which is where the individual is not aware of the reasons for why they gamble (Chantal et al., 1994).

Clarke (2004) found in twenty-five problem gamblers (scores greater than 3 on the SOGS) that they were significantly more motivated to gamble to experience stimulation, relieve guilt/tension, and prove oneself to others. The problem gamblers also rated higher on amotivation, which the author suggested may signpost the individual has lost control of their gambling behavior (Clarke, 2004).

However, the need to experience stimulation may characterise individuals with severe problem gambling. For example, Ladouceur, Arsenault, Dubé, Freeston, and Jacques (1997) found 30 pathological gamblers (SOGS = 5+) rated higher on items of excitement/stimulation for why they gamble, compared to probable pathological gamblers (SOGS = 3-4); however, the groups did not differ in reports of gambling to relieve psychological distress and amotivation. Motivations also differ according to the forms of gambling individuals become addicted to. For example Cocco, Sharpe, and Blaszczynski (1995) found problem poker machine gamblers were significantly more anxious and gambled to escape this arousal, compared to problem horse racers who gambled to heighten their levels of arousal.

Male college students who had gambled at least once in the past 6-months have been found to endorse greater *intrinsic motivations* for gambling and higher levels of competitiveness compared to women who gamble (Burger, Dahlgren, & MacDonald, 2006). Other research has found women problem gamblers gamble to escape from emotional distress in their lives (Wenzel & Dahl, 2009). In one sample of women, 61% reported gambling to ‘cheer myself up’, 53% for stress relief and 49% for escape (Boughton & Falenchuck, 2007). In addition, women with problem gambling have been found to respond to stress with greater emotional distress and impulsivity (Getty, Watson, & Frisch, 2000). Poor communication and self regulation has also been related to increases in gambling severity (Toneatto, Lecce, &

Bagby, 2009). This may suggest difficulties in emotional processing/regulation is also characteristic of more severe gambling problems. When these risk factors align, and individuals have the opportunity to gamble on activities, perhaps they will be more at risk for developing problems with gambling.

Addictive Forms of Gambling

There are patterns emerging in the literature of gambling activities engaged in that differentiate social from problematic gamblers. To illustrate, El-Guebaly et al. (2006) found in 2.7% of their sample who had moderate to severe levels of gambling also reported frequently gambling on electronic slot machines, while non-problematic gamblers reported playing the lotteries. The relationship of problematic gambling and electronic gaming/slot machines is also consistent across gender. For example, Paton-Simpson et al. (2002) revealed in a New Zealand sample 67.6% of males and 77.5% of females reported non-casino gaming machines as their most problematic form of gambling; this relationship has also been found in other countries such as Australia (Jackson, Thomason, Ryan, & Smith, 1996). Furthermore, 81.6% of individuals presenting to gambling helplines reported non-casino gaming machines their problematic form of gambling (Abbott, 2001). Thus, research is demonstrating a clear pattern of slot machines being the form of gambling that has the potential to 'hook' individuals into a pattern of problem gambling.

Some researchers have suggested that electronic gaming/'slot' machines have an 'addictive potential' which can be the vehicle that drives vulnerable individuals to rapidly progress to problem gambling (Dowling, Smith, & Thomas, 2004). El-Guebaly et al. (2006) attributed the relationship of problematic gambling with slot machines being due to the greater chance of 'immediate reward' that is more prominent compared to other forms of gambling such as lottery. In addition, it is likely features of slot machines make them

reinforcing due to their interspersed short-term increases in money, at the expense of long-term losses (Griffiths, 1999).

Griffiths (1999) made the distinction between 'soft' (e.g. lottery) and 'hard' (e.g. blackjack, slot machines) forms of gambling, differentiated by the frequency an individual can continue to re-gamble, which he termed 'high event frequencies'. Welte, Barnes et al. (2004) in a National survey in the USA, found casino gambling and 'pull-tabs' that had 'high event frequencies' were highly associated problematic gambling, compared to gambling on the lotteries, and betting on sports. They also found those 'at risk' for problem gambling had gambled on a greater variety of activities, and suggested this may indicate an attachment to gambling (Welte, Barnes et al., 2004). Gambling on a greater variety of activities may also reflect the reinforcement some individuals receive from gambling on activities. Griffiths (1999) noted in general our society is continuing to accommodate 'asocial' forms of gambling, such as slot machines and the rise of internet gambling, which may have more detrimental consequences. Indeed, a trend has been found of internet gambling being linked with severe gambling pathology (Welte, Barnes et al., 2004). Individuals who seek gambling activities, are socially isolated, plus have an oversensitivity to reward may be particularly at risk for developing problems with gambling.

Impulsivity and Decision-Making: Chasing Losses

A behavior associated with perpetuating problematic gambling, has been termed 'chasing-losses' and is characteristic of pathological gamblers who attempt to regain lost money through continued gambling (APA, 2000). Chasing-losses is often the single behavior which leads to severe problems such as financial loss (Lesieur & Blume, 1987) and the progression to problematic gambling when the individual engages in this behavior over long periods of time (APA, 2000). For example, Black and Moyer (1998) found all 30

pathological gamblers from their study reported gambling more money than expected in one session, and 70% reported feeling they were unable to stop gambling.

The behavior of continuing to gamble money within a session may be related to neuropsychological deficits of an individual arising from heightened levels of impulsivity, and expressed in poor decision-making. Indeed, problem gamblers have been found to have higher levels of impulsivity (Castellani & Rugle, 1995), and self-reported impulsivity has been found to contribute to 4% of the variance in the prediction of problem gambling in a sample of New Zealand university students (Clarke, 2004). Pathological gamblers have also been found to make more commission errors (impulsive responses) on a Go-No/Go task however, did not differ in the rates of omission errors (inattentiveness) compared to the controls (Goudriaan, Oosterlaan, de Beurs, & van den Brink, 2005). This may suggest it is higher levels of impulsivity, characterised by an inability to stop that may lead to severe gambling problems.

Further, Vitaro et al. (1999) discovered in a longitudinal study that higher levels of self-reported impulsivity and more trials played on a Card Playing Task (a decision-making task that measures ‘response perseveration’) in 13-14 year olds uniquely predicted problematic gambling at 17-years of age, above other factors such as low SES. Similarly, Goudriaan et al. (2005) revealed pathological gamblers have deficits on a range of decision-making tasks, with slot machine players performing worse on the Iowa Gambling Task, and casino players making poorer choices on the Card Playing Task. In another study, Gouchiaan, Oosteriaan, Beus, and Den Brink (2008) found deficits in decision-making on the Card Playing Task and disinhibition as measured by Stop Signal reaction times accounted for 53% of variance in the relapse of pathological gamblers. Pathological/problem gamblers with these neuropsychological deficits have been suggested to reflect an ‘endophenotype’ of problem

gamblers, who may be more vulnerable to relapse and resistant to treatment (Gouchiaan et al., 2008).

Brain regions that mediate this relationship of poor decision-making have been revealed in gamblers and healthy adults through neuroimaging, to further understand these complex processes that may lead to chasing losses. For example, poor performance on a Card Playing Task has been found to concurrently reflect less activation of the Ventromedial Prefrontal Cortex (VMPFC) and less activation of the meso-limbic system in pathological gamblers (Reuter et al., 2005). In addition, more severe levels of pathological gambling has been related to less activation in the VMPFC (Reuter et al., 2005). Similarly, individuals with lesions in the VMPFC are more likely to make poorer decisions both on gambling tasks and in everyday decisions, which has been suggested to reflect an impairment of integrating emotional signals during decision-making (Bechara, 2004).

Additionally, research has found in healthy adults who decided to quit on a Card Playing Task had increased activity in subcortical areas involved in processing negative states, and less in activity in cortical areas processing reward. Therefore, those who have decision-making deficits may be driven by the reinforcement of rewards that gambling provides, and be insensitive to potential losses. Indeed, the authors suggested that decisions to quit on a gambling task may involve a balance of activity in both the reward and punishment neural systems, which if not integrated may lead to chasing losses behavior (Campbell-Meiklejohn, Woolrich, Passingham, & Rogers, 2008).

These executive functioning deficits and lowered activation of brain regions align with research revealing lowered dopamine in pathological gamblers (Bergh, Eklund, Sodersten, & Nordin, 1997). Further, experimental research has found the administration of dopamine antagonists (inhibit dopamine transmission) increases the desirability of gambling on slot machines in a sample of pathological gamblers (Zack & Poulous, 2007). These

neuropsychological deficits present in pathological/problem gamblers during experimental gambling tasks also parallel cognitive bias reported by problem gamblers which may be interrelated and perpetuate further gambling.

Gambling Cognitions and Chasing Losses

Distorted/irrational cognitions related to gambling behavior have been identified among regular gamblers (Griffiths, 1994) and those who are at risk for pathological gambling (Baboushkin, Hardoon, Derevensky, & Gupta, 2001). Raylu and Oei (2004) identified five cognitive biases associated with problem gambling through confirmatory factor analysis. These cognitive biases include; interpretative control (e.g. “relating my losses to bad luck and bad circumstances makes me continue gambling”), illusion of control (e.g. “praying helps me win”), predictive control (e.g. “when I have a win once, I will defiantly win again”), gambling-related expectancies (e.g. “gambling makes things seem better”) and perceived inability to stop (e.g. “I will never be able to stop gambling”) (Raylu & Oei, 2004).

Greater endorsement of these gambling-related cognitions has been found to reflect higher scores on the South Oaks Gambling Screen (SOGS) (Oei, 2008) and predict future relapse into problem gambling (r = -.41) (Oei & Gordon, 2008). Källmén et al. (2008) found that problem gamblers differed in their cognitions of believing they had more skill, and their skill affected whether they won or not compared to gamblers with a SOGS score below three. In addition, Delfabbro and Winefield (2000) found in 20 regular slot machine players while speaking aloud during a gambling task, verbalised more irrational thoughts of believing they were winning despite their losses, which the authors suggested may perpetuate their continued gambling. These gambling cognitions appear to be reflecting an oversensitivity to reward, which appears to be evident in the neuropsychological tasks.

In fact, Rugle and Melamed (1993) purported some of these gambling cognitions may be related to neuropsychological deficits, including behavioral disinhibition, poor decision-making and inattention. This was supported by Campbell-Meiklejohn et al. (2008) who found during a gambling task participants (SOGS scores = 0-1) who reported they believed they would continue to win ("interpretive bias") had hypoactivation in 'affective' subcortial areas which were are activated in participants who quit the task. Interestingly, Oei and Gordon (2008) found higher levels of social support was related to having fewer gambling related cognitions, and abstaining from gambling, which has obvious implications for treatment of problem gamblers.

Subtypes of Pathological/Problem Gamblers

Researchers are beginning to conceptualise pathological/problem gambling as heterogeneous, and focusing on identifying subtypes of gamblers who may require different specialised treatment (Blaszczynski & Nover, 2002). Indeed, motivations, activities gambled on, and neuropsychological functioning differ with the degree of problem gambling. Reflecting these differences, Blaszczynski and Nover (2002) derived from the gambling literature three distinct subgroups of pathological gamblers that may exist; the behaviorally conditioned, the emotionally vulnerable and the antisocial-impulsivist. These different subtypes appear to characterise both problem and pathological gamblers, although the difficulties in each of these subtypes likely exist on a continuum.

More recently Lederwood and Petry (2006) sought to validate these hypothesized subtypes through exploring pathological gamblers reports of experiences while gambling. They found three heterogeneous subtypes of gamblers in their sample; to escape emotional distress, to dissociate, and to seek attention which they termed 'egotism'. The Egotism was characteristic of male problem gamblers who had greater levels of impulsivity (Lederwood &

Petry, 2006). This aligned with the 'antisocial impulsivist' subtype proposed by Blaszczynski and Nover (2002), where these individuals possess impulsive traits or Attention-Deficit/Hyperactivity Disorder (ADHD) and exhibit severe problematic gambling which is resistant to treatment.

Indeed, poorer response to problem gambling treatment has been found in individuals who scored higher on the personality trait of 'dysfunctional impulsivity', which represents the inability to plan or delay responses (Maccullum et al., 2007; Dickman, 1990). Rodriguez-Jimenez et al. (2006) postulated if treatment is matched to the individuals underlying pathology of problem gambling, individuals are more likely to benefit from treatment. In addition, it is vital to explore at-risk populations who are vulnerable to problem gambling due to their neuropsychological vulnerabilities underlying their impulsive behavior. ADHD is one proposed subtype vulnerable to problem/pathological gambling, due to heightened levels of impulsivity. Individuals with ADHD are also particularly vulnerable due to their increased rates of psychiatric comorbidity, mood instability/emotion dysregulation and impairment in everyday life.

Attention-Deficit/Hyperactivity Disorder (ADHD): Overview

Attention-Deficit/Hyperactivity Disorder (ADHD) is a common heterogeneous childhood disorder with a prevalence of 3-7% in school-aged children (APA, 2000) and 5.29% worldwide (Polanczk, de Lima, Horta, Biederman, & Rohde, 2007). ADHD has three main subtypes, Predominantly Inattentive Type, Hyperactive/Impulsive Type and Combined Type (APA, 2000). Symptoms of inattention can include difficulty with sustaining attention, poor organisation and difficulty listening to others, and six of nine symptoms must be present to meet criteria for Predominantly Inattentive Type. There are also nine hyperactive/impulsive symptoms described, examples include; fidgeting, being "on the go",

talking excessively, interrupting and intruding on others and often blurting out answers before the question has been completed. Six of nine hyperactive/impulsive symptoms must be present to receive a diagnosis of Hyperactive/Impulsive Type or in combination with inattentive symptoms to met criteria for Combined Type of ADHD. These symptoms must also be present before 7-years of age with evidence of impairment in two or more settings, and not be better accounted for by another psychiatric disorder (APA, 2000).

Over the last 20 years, research into adult ADHD has increased due to studies revealing the disorder continues into young adulthood (Barkley, Fischer, Edelbrock, & Smallish, 1990; Hart, Lahey, Loeber, Applegate, & Frick, 1995) and adulthood in 30-50% of individuals (Weiss & Hechtman, 1993). Current prevalence rates of ADHD in adults have been estimated at 4.4% in the general population (Kessler et al., 2006). However, there is a mounting recognition of a different expression of ADHD throughout development, where symptoms of hyperactivity and impulsivity decline over time while the more subtle inattentive symptoms remain (Lenard, 2004; Hart et al., 1995).

Indeed, the current behavioral criterion used to define ADHD has been criticized as not reflecting the changing expression of ADHD symptoms throughout development, and particularly in adulthood (Barkley, 2003). In response, some researchers have proposed the ADHD diagnostic criteria should be adjusted for adults, such as meeting a minimum of four hyperactive, impulsive or inattentive symptoms as an alternative to placing adults who do not meet current criteria in the ‘ADHD Not Otherwise Specified’ diagnostic category (McGough & Barkley, 2002). It is clear research needs to guide future decisions of the diagnostic criteria of ADHD, to better accommodate adults who suffer from these symptoms, and promote valid research in this area.

Although a gender-bias of 9:1 has previously been reported for boys (APA, 2000), this may have been due to clinician, teacher and parent bias and research being primarily

conducted on males (Staller & Faraone, 2006). Females with ADHD generally have lower rates of disruptive behavior compared to males with ADHD, likely contributing to fewer referrals to psychiatric services (Biederman et al., 1994). Currently, there is an increasing recognition that females are equally likely to have ADHD compared to males (Staller & Faraone, 2006) which continues into adulthood and often results in an increase in disruptive behavior, anxiety, substance dependence, and risk for major depressive disorder (Biederman et al., 2006; Biederman et al., 2008) along with high symptom distress and stress levels (Rucklidge & Tannock, 2001). In addition, functionally compared to controls, women have been found to have higher rates of school failure (Biederman et al., 1994).

ADHD and Associated Problems

Research has revealed that adults with ADHD will often present with inattention, distractibility, organisation difficulties and poor efficacy (Faraone et al., 2000; Spencer, Biedermann, & Mick, 2007). However, the presentation of ADHD as outlined in the DSM-IV is also apparent in a variety of other psychiatric disorders. In response, some researchers have suggested the diagnostic criteria for ADHD needs to be refined, to assist with differentiating it from other psychiatric disorders (McGough & Barkley, 2002).

However, individuals with ADHD often have comorbid psychiatric disorders, which may reflect the associated impairment arising from the disorder. For example, in a National Comorbidity Survey Replication, 47.1% of adults with ADHD met criteria for any anxiety disorder and 15.2% for any substance-use disorder. The most prevalent anxiety disorder, reported was social anxiety disorder, which occurred in 29.3% of the sample (Kessler et al., 2006).

Differences in rates of associated psychiatric disorders have also been found in relation to the hyperactive/impulsive and inattentive subtypes of ADHD, in both children and

adults. For example, Sobanski, Brdggemann, Alm, Kern, and Philipsen (2008) found adults with ADHD Combined Type and inattentive/amnestically combined type, had significantly more substance-use/dependence compared to Predominatly Inattentive Type of ADHD. In fact, adults with ADHD who have hyperactive/impulsive symptoms are more likely to present with greater psychiatric comorbidity (Millstein, Wilens, Biedeman, & Spencer, 1997). Sprafkin et al. (2007) found Combined Type of ADHD in adults aged 17-27 years had greater levels of Oppositional Defiant Disorder, Posttraumatic Stress Disorder and Antisocial Personality Disorder, compared to Predominately Inattentive Type and Hyperactive/Impulsive Type. Similarly, children with ADHD Combined Type have been found to be more socially impaired, and display more delinquent and aggressive behavior compared to Predominantly Inattentive Type (Gross-Tsur et al., 2006).

In addition to the clinical picture of greater rates of psychiatric disorders, individuals with ADHD often have a labile/instable mood. Recently researchers have suggested due to the frequent presentation of mood instability in individuals with ADHD, it should be conceptualised as a core symptom of the ADHD syndrome (Skirrow, McLoughlin, Kuntsi, & Asherson, 2009). Barkley (1997) proposed emotional disregulation is reflecting weaknesses in executive functioning, which leads to poor control of internal states. Interestingly, extreme emotional affectivity has also been found to contribute to emotional recognition deficits and poor social competence in interpersonal situations (Rapport, Friedman, Tzelepis, & Van Voorhis, 2002). Emotion recognition deficits has also been discovered in children with ADHD, and found to contribute to difficulty matching emotions to situations, independent from general executive deficits (Yuill & Lyon, 2007). The causes of this mood instability and emotion recognition difficulties has been suggested to stem from impairment in executive functions and subcortial arousal deficits, which worsen with the severity of ADHD symptoms (Skirrow et al., 2009).

ADHD and Neuropsychological Functioning

Although ADHD is defined and diagnosed based on behavioral presentations, it is well-known the neuropsychological weaknesses often underlying the condition. To date, researchers have proposed there are multiple neuropsychological etiologies affecting cognitive functioning and accounting for the heterogeneity of the behavioral symptoms (e.g., Nigg, 2006). Barkley (1997) conceptualised ADHD as a disorder of self-regulation, and proposed an influential unifying model of ADHD for the combined/hyperactive subtypes of the disorder. Specifically, Barkley (1997) suggested impaired behavioral inhibition accounts for the executive deficits and behavioural symptoms present in those with ADHD. These deficits include: poor *self regulation of affect*, where individuals cannot modify an initial emotional response, or modify it to reach a desired goal; poor *internalization of speech* which pertains to the ability to self-reflect, internalise rules, and effectively problem solve and poor *working memory*, the ability to hold information in the mind and manipulate it. These deficits have been proposed to effect *motor control/fluency*, that is the ability to respond to feedback, inhibit behavior and persist in goal-directed activities (Barkley, 1997).

Certainly, research has continued to support the proposed deficits in behavioral inhibition and executive functioning in individuals with ADHD across development, although, there has been conflicting evidence. For example, adolescents have been found to make more commission errors on a Go/No-Go paradigm compared to controls (Schulz et al., 2005). However, other measures of behavioral inhibition (interference) as measured on the Stroop Task, has not found to be more impaired in adolescents with ADHD, although naming and processing speed has (Rucklidge, 2006). In contrast, others have found adults with ADHD have worse performance on the Stroop interference and make more perseverate errors but do not differ from the controls on areas of organisation, or working memory (Rapport, Van Voorhis, Tzelepis, & Friedman, 2001).

These differences in the full sample of individuals with ADHD in some circumstances may be a reflection of different severity of hyperactivity/impulsivity and inattention in the samples. Indeed, some researchers have proposed ADHD subtypes are fundamentally distinct disorders across numerous domains, including neuropsychological functioning (Milich, Balentine, & Lynam, 2002). Differences in subtypes has been found in recent research, for example Nigg, Blaskey, Huang-Pollock, and Rappley (2002) found in males and females with ADHD Combined Type had poorer motor inhibition and planning, however, did not differ from Predominately Inattentive Type in terms of vigilance/effort. Yet, others have found Predominately Inattentive Type of ADHD are more impaired in the domains of processing speed, vigilance and inhibition, compared with the other subtypes of ADHD (Chhabildas, Pennington, & Willcutt, 2001).

Recently researchers have broadened the scope of executive functioning, arguing there are two types including, “cool” executive functions mediated by the Dorsolateral Prefontal Cortex (DLPFC), and “hot” executive functions mediated by the Ventral Medial Prefrontal Cortex (VMPFC) (Zelazo & Müller, 2002). Impaired functionnig of the VMPFC can lead to poor integration of emotional signals or poor input from the affective systems to adequately guide in decision-making (Zealot & Müller, 2002). Therefore, the influence of emotional information on cognitive control differentiates the ‘hot’ from the ‘cool’ executive functions. In addition, ‘cool’ cognition represents abstract thinking, working memory and more general cognitive functions (Zealot & Müller, 2002).

Similarly, researchers have proposed in individuals with ADHD there will be impairment in different neural systems, either through the nigrostriatal pathway ‘top down’ or the mesolimbic pathway ‘bottom up’, or both (Sonuga-Barke, 2003); this heterogeneity of neural impairment was suggested to reflect the multiple causal pathways that can lead to symptoms of ADHD (Sonuga-Barke, 2003). The notion of ‘bottom-up’ impairment in

cognitive functioning is similar to earlier proposals of a deficit in the Behavioral Inhibition System (BIS) in those with ADHD, arising from poor functioning of the septal-hippocampal areas (Quay, 1997) based on Gray's (1982) neurobiological theory of anxiety. Specifically, Quay (1997) purported that poor performance on tasks of behavioral inhibition (e.g. Stop Signal / Go/No-Go tasks) is reflecting the impaired functioning of the BIS, and consequently the individual is less responsive to cues of punishment, and makes more impulsive responses. However, research has been inconsistent with the BIS theory and the Go/No-Go tasks have been criticized for being insensitive, and therefore unable to activate the BIS system (Nigg, 2006). It may be that deficits are in the behavioural inhibition as conceptualized by Quay (1997) is better reflected in more recent theories of bottom-up/motivational cognitive deficits.

Bottom-up or 'hot' cognition has been proposed to be reflected in the performance on emotional and decision-making paradigms, whereas 'cool' (top-down) executive functioning deficits, have been suggested to represent those general cognitive functions typically assessed by neuropsychological batteries, such as reaction time, planning, set-shifting, and commission /omissions errors on the Go/No-Go (Castellani & Rugle, 1995). Adults *without* ADHD have been found to perform better on measures of 'behavioral inhibition' (i.e. 'cool' executive functioning) (Stroop Task, Stop Task) and 'motivational inhibition' (i.e. 'hot' executive functioning) (Iowa Gambling Task, Card Playing Task, Emotional Stroop), which was related to lower self reports of inattentive and hyperactive/impulsive symptoms (Shuster & Toplak, 2009). However, deficits in 'bottom-up' or 'hot' executive functioning have been found in adults with ADHD. For example, Ernst et al. (2003) found adults with ADHD had poorer performance in a decision-making task, which corresponded to less widespread activation of the cingulate and hippocampus; the authors suggested this hypoactivation represented poor emotional representation of past experiences to guide future behavior.

Castellanos et al. (2006) argued that neurological impairment in ADHD is heterogeneous and proposed 'hot' executive weaknesses (poor decision-making, emotional processing) would be evident in the Hyperactive/Impulsive Types of ADHD, whereas 'cool' executive functioning weaknesses (general cognitive deficits) would be apparent in the Predominantly Inattentive Type. In addition, Castellanos et al. (2006) proposed the Combined Type would have deficits in both 'hot' and 'cool' cognitive domains. Differences in 'hot' executive functioning across subtypes has been found more recently, for example, Bubier and Drabick (2008) found in 63 children, those with ADHD Hyperactive/Impulsive Type performed worse on the Iowa Gambling Task and that decreased sympathetic functioning was mediating this relationship; however, this was not found in the Inattentive subtype. The performance on the Iowa Gambling Task was also not related to performance on the other executive function measures, suggesting they were measuring different areas of cognition (Bubier & Drabick, 2008). Adolescents with ADHD have also been found to make poorer choices on a Card Playing Task compared to controls, with parental reports of hyperactive/impulsive symptoms being related to poorer decision-making (Toplak, Jain, & Tannock, 2005).

Poor functioning of both 'cool'/'top-down' and 'hot'/ 'bottom-up' areas of the brain has been suggested to impact on the social functioning of individuals with ADHD (Skirrow et al., 2009). Indeed, children with ADHD have been found to be significantly poorer at recognizing facial emotions (Fonseca, Seguier, Santos, Poinso, & Dervelle, 2009) and adults with ADHD have been found to score higher on measures of alexithymia, and perform poorer on tasks of emotion recognition, despite similar visual-spatial skills as controls (Freidman & State, 2000). In line with this, higher levels of alexithymia has been related to a worse performance on the Iowa Gambling Task (Ferguson et al., 2009). This adds further support to

the proposals of close interconnections between emotional processing and performance on decision-making tasks, characterising ‘hot’ cognition.

ADHD and its Relationship to Problem/Pathological Gambling

The recent research into the decision-making deficits in ADHD is paralleling the research of decision-making deficits in problem/pathological gamblers. Specifically, there are similar characteristics between the two disorders of marked impulsivity, and poor engagement of sub-cortical areas of the brain to help guide decisions of when to quit. Previous research has explored the prevalence of ADHD in a sample of pathological gamblers. For example, Carlton, Manowitz, and McBride (1987) initially explored this broad relationship and found 14 pathological gamblers reported higher ratings of primary symptoms of ADD in childhood compared to 16 controls. Speaker, Carlson, Christenson, and Marcotte (1995) found in 40 pathological gamblers 20% reported having a childhood history of ADD, and 18% met subthreshold diagnosis for past ADD criteria. In addition, Dannon, Lowengrub, Aizer and Kotler (2006) found three of fifty-two male pathological gamblers had past diagnoses of Attention Deficit Disorder, however, it was unclear how this diagnosis was established.

Carlton and Manowitz (1992) revealed while most pathological gamblers reported a childhood history of ADHD, only a subset evidenced defects in behavioral restraint (similar to the alcoholic subgroup), while another subtype of gamblers had a slower reaction times which may be more reflective of the attentional deficits associated with ADHD. This may suggest both Inattentive and Combined/ Hyperactive/Impulsive subtypes of ADHD are vulnerable to problem gambling. However, the study had limited power and the measures were not psychometrically sound.

In addition, Rodriguez-Jimenez et al. (2006) found 29.1% of pathological gamblers had a childhood history of ADHD, who performed worse on a Stop Signal and delayed gratification tasks, than pathological gamblers without ADHD. However, there were no differences in sustained attention between the two groups (Rodriguez-Jimenez et al., 2006) which may indicate a general vulnerability to problem gambling as these activities may sustain their attention. A caveat of this research was the use of retrospective reports to obtain a childhood ADHD diagnosis, rather than a careful evaluation of past and current ADHD symptoms. More recently, Breyer, Botzet and Winters (2009) found young adults with ADHD had higher rates of problem gambling (SOGS for adolescents of scores greater than 2), more trouble with the law, and greater employment problems, compared to the controls and individuals with ADHD in remission. However, they did not explore if neuropsychological functioning was mediating this gambling behavior, along with motivations and cognitions for gambling and levels of social support.

This study examines the relationship of adults with ADHD globally in terms of the distribution of lifetime severity of problem gambling, and reports of whether they have ever felt they had a problem with gambling, or had felt guilty about the way they gamble. Another aim is to explore the type of problematic gambling behaviour most frequently reported, gambling activities played in a lifetime, and reports of their motivations for gambling, and thoughts experienced while gambling.

In addition, this research also documents both ‘hot’ and ‘cool’ aspects of executive functioning in adults with ADHD, and its relationship to gambling severity. Further, we aim to explore levels of social support across gambling groups in the ADHD sample, and social support, symptoms of depression, anxiety and stress, plus areas of stress for individuals with ADHD, as compared to controls; which may provide indications of the extent of impairment across neuropsychological and psychosocial domains in this sample.

Given the paucity of research on gambling in adults with ADHD, it is worth exploring this relationship further. In addition, given the recent conceptualization of impairment across 'hot' and 'cool' cognitive functioning in individuals with ADHD, it is worth exploring this and its relationship to gambling severity within the ADHD group.

Hypotheses:

1. In terms of gambling it was hypothesized that the ADHD group would: (a) have higher frequencies of *probable pathological gambling* and *some problems with gambling* (b) have greater reports of ever feeling guilty about the way they have gambled / felt they have had a problem with gambling (c) report higher rates of problematic gambling behaviour (d) report higher lifetime rates of *ever* playing on 'continuous' forms of gambling (e.g. slot machines, casino) (e) have higher ratings of motivations for gambling and cognitions experienced while gambling.
2. It was also predicted that individuals with ADHD who were categorised as having some problems with gambling and probable pathological gambling would report less social support and display poorer performance on both 'hot' (decision-making/emotional processing) and 'cool' (reaction time, planning, set shifting) neuropsychological measures, compared to those with no reported problems with gambling.
3. Lastly, it was hypothesized that: (a) the sample of adults with ADHD would perform poorer on both 'cool' (e.g. processing speed, omissions, commissions, planning, set-shifting), and 'hot' cognitive functioning (e.g. Card Playing Task and emotional processing) (b) and the ADHD group would report greater levels of stress, symptoms of depression, anxiety and stress, and have less social support compared to the control group; which would indicate the vulnerability this group had to developing problems with gambling in a lifetime.

Method

Participants

The final sample consisted of 58 participants, 30 with ADHD, (16 men, 14 woman) with a mean age of 35.25 years (*SD* = 13.25; range = 17.30 - 64.30) and 28 participants without ADHD (14 men, 14 women), with a mean age of 30.48 years (*SD* = 11.54; range = 19.30 - 56.10) (F (1, 56) = 2.210, p = .151). The ADHD group was referred from the community, including general practitioners, single point of entry (Canterbury District Health Board), private psychiatrists/psychologists, and databases by previous studies approved by the ethics committee and self-referrals to the University of Canterbury. The participants without ADHD were recruited through advertisements in the community, and previous studies approved by the ethics committee. All participants provided their written consent prior to commencing the study, and were compensated with a $10 petrol voucher for their participation.

In total 20 (71.4%) from the control group, and 22 (73.3%) from the ADHD group identified as European New Zealanders. One (3.6%) participant from the control group identified themselves as Maori (indigenous people of New Zealand). Two (6.7%) of the ADHD participants, and four (14.3%) from the control group identified as an Asian ethnicity. The remainder six (20%) participants from the ADHD group and three (10.7%) participants from the control group identified as Other European (χ^2 (4, N = 58) = 2.696, p = .44).

Diagnostic Protocol for ADHD and Other Psychiatric Disorders

Structured Clinical Interview for DSM-IV-TR AXIS I Disorders (SCID) (First, Spitzer, Gibbon, & Williams, 1996). The SCID was used to screen for lifetime and current psychological disorders. Firstly we established an overview of current functioning and then screened for current/past psychological disorders (alcohol/substance-use, panic attacks,

agoraphobia, social phobia, specific phobia, obsession, compulsions, generalised anxiety, anorexia and bulimia/anorexia nervosa). Screening questions endorsed by participants were explored in more depth. Current and lifetime mood disorders (major depressive episodes, dysthymia, bipolar I & II) were also examined. A screening module was used to establish the presence of current or past episodes of psychosis. The presence or absence of a psychological disorder was coded through meeting specified criteria as outlined in the SCID. This interview took approximately 30-60 minutes, and was completed by both the control and ADHD participants.

The Conners Adult ADHD Rating Scale (CAARS; Conners, Erhardt, & Sparrow, 1999) was used to screen for the presence of significant ADHD symptoms as well as provide information on the severity of such symptoms. The rating scales consisted of a self and observer report, each containing 66 questions. Participants were required to fill in the self report and give the observer report to someone close to him or her to complete about them (e.g. a spouse). Each question was rated on a 4-point scale from *not at all/never* (0) to *very much, very frequently* (3). The questionnaires consist of a number of subscales including: inattention/memory problems, hyperactivity/restlessness, impulsivity/emotional liability, problems with self-concept, DSM-IV inattentive symptoms, DSM-IV hyperactive/impulsive symptoms, DSM-IV ADHD symptom total and the ADHD index. An example of a question from the DSM-IV inattentive subscale is; ‘Misjudges how long it takes to do something or go somewhere’. An example of a question from the DSM-IV hyperactive/impulsive subscale is ‘Interrupts others when they are working or busy’. Higher T-scores on these two scales represent greater severity of ADHD symptoms. Both the control and the participants with ADHD completed the CAARS. The CAARS has been reported to have a median test-retest

reliability of .89, and coefficient alphas ranging from .86 to .92 (Conners et al., 1999). Each questionnaire took approximately 10-15 minutes to complete.

Conners' Adult ADHD Diagnostic Interview for DSM-IV (CAADID; Epstein, Johnson & Conners, 2000). This semi-structured interview consisted of two parts. Part I of the interview assessed areas such as developmental history (gestational, delivery and temperamental risk factors) as well as information on medical, environmental and psychological risk factors. Information was also obtained on their schooling, occupational and family history, which were crucial areas for an accurate assessment of ADHD. Part II of the diagnostic interview, assessed each of the ADHD inattentive (9 symptoms) and hyperactive/impulsive symptoms (9 symptoms) across childhood and adulthood. Using the CAADID responses, participants were then classified according to an ADHD subtype; Combined Type, Predominantly Inattentive Type or Predominantly Hyperactive/Impulsive Type. This interview took approximately 60 minutes to complete, and was administered to the ADHD participants only.

Inclusion Criteria for ADHD Only

To be included in the ADHD group, a participant had to meet each of the following criteria: (a) a stringent cutoff T-score of 70 on the CAARS self *and* observer report on *either* the DSM-IV inattentive or hyperactive/impulsive subscale as recommended by Conners et al. (1999); (b) DSM-IV diagnostic criteria for ADHD based on meeting 6 of the 9 symptoms for either category of inattention or hyperactivity/impulsivity, established by the CAADID; (c) evidence of ADHD symptoms prior to seven years, established either with the CAADID, interview with parent/spouse, or review of previous school report cards; (d) evidence of impairment of the symptoms in everyday life.

Exclusion Criteria for the Control Group

Exclusion criteria for the control group included: (a) a history of significant problems with inattention or hyperactivity/impulsivity; (b) T-scores above 60 on the DSM-IV inattentive and hyperactive/impulsive subscales of the CAARS (observer or self reports). These criteria resulted in four controls being excluded; one due to a recent head injury and three others due to T-scores scores on the CAARS above the control cut-off criteria of 60. Exclusion of participants was based on these criteria, as high T-scores on the CAARS questionnaires could suggest these individuals had attentional/impulsivity deficits.

Exclusion Criteria for ADHD and Control Groups

Participants were excluded from analyses if they had: (a) an estimated IQ below 70 as measured by the Block Design and Vocabulary subtests of *The Wechsler Adult Intelligence Scale (WAIS-III)* (Wechsler, 1997). The dyad combination have high reliability (r_{xx} = .93) and validity (r = .876) and took approximately 26 minutes to administer (Sattler, 2001); (b) individuals who had a pervasive developmental disorder, recent head injury, psychotic disorder, and those who were identified as having ADHD in remission were also excluded.

Measurement of Demographic Variables

New Zealand Socioeconomic Index of Occupational Status (NZSEI; Davis, McLeod, Ransom, 1997). The NZSEI is based on 1991 New Zealand census data and scores range from 10 and 90 (with higher scores indicating higher SES). This scale provided an estimate of socioeconomic status (SES) based on the individuals' and partner's occupational level.

History Questionnaire. This questionnaire was used to assess for demographic variables. Participants were provided categories to select the following; annual income before

tax (ranging from $20,000-$70,000), ethnicity (New Zealand European, Maori, Tongan, Nui, Chinese, Indian, Other European), marital status (married/cohabitating, divorced/separated, dating), home situation (living with dependent children, flatting with others, living alone, supporting parents/relatives, living with partner/wife), and highest educational qualification (ranging from no school qualifications to a University postgraduate degree). Participants were also asked to list their occupation and partners if applicable. In addition, they were asked to list any medications they were currently being prescribed (see Appendix A).

Dependent Measures: Gambling Behavior, Cognitions and Motivations

South Oaks Gambling Screen (SOGS). The South Oaks Gambling Screen (Lesieur & Blume, 1987) is a 20-item questionnaire based on the DSM-III-R criteria of Pathological Gambling. The final score was a sum of problematic gambling behavior endorsed in a lifetime, as specified by the questionnaire. Individuals who obtained scores greater than 5 on the questionnaire were categorised as being a 'probable pathological gambler'. We also sought to classify those with 'some problems with gambling' as ranging from (1-3) and those with 'no problems with gambling' receiving a score of zero; this has previously been used to classify participants in other studies (e.g. Baboushkin et al., 2001). Other variables of interest from the questionnaire were reports of ever feeling they had a problem with gambling, and ever feeling guilty about their gambling. In addition, the type problem gambling behavior reported, forms of gambling played, and friends or family with known gambling problems were of interest. The South Oaks Gambling Screen exhibits excellent internal consistency, Cronbach's $\alpha = .97$ (Lesieur & Blume, 1987) and good clinical validity (Stinchfield, 2002). A copy of the questionnaire is provided in Appendix B1.

Gambling Motivations Scale. The Gambling Motivations Scale (Chantal et al., 1994) is a self-report questionnaire that was used to measure an individual's reasons for gambling. Participants were asked to rate the extent the 28-statements applied to them while playing their favorite gambling activity. For each statement, a seven-point Likert Scale was used ranging from *does not correspond at all* (1) to *corresponds exactly* (7). These statements measured three subscales associated with 'Intrinsic Motivations' to gamble; *Stimulation* e.g. "For the thrill or the strong sensations it gives me"; *Knowledge* e.g. "For the pleasure of knowing my abilities at the game" and *Accomplishment* e.g. "For the feeling of efficacy that I get when I play my favorite game". In addition the questionnaire provided three subscales associated with 'Extrinsic Motivations' for gambling; *External Regulation* e.g. "To make money quickly and easily"; *Introjected Regulation* e.g. "Because it makes me feel like somebody important" and *Identified Regulation* e.g. "Because for me, it is the best way to relax completely". Lastly, the measure provided a subscale measuring *Amotivation* e.g. "I play for money, but sometimes I ask myself what I get out of it". Each subscale was scored through summing the rating of the statement associated with the subscale, and dividing it by the number of questions to produce a mean rating. Higher scores represented greater correspondence with the motivations of the questionnaire. The Gambling Motivations Scale exhibits acceptable internal consistency, Cronbach's α= 0.69-0.89 (Chantal et al., 1994). This task took approximately 5-7 minutes to complete. A copy of the questionnaire is provided in Appendix B2.

Gambling Related Cognitions Scale. The Gambling Related Cognitions Scale (GRCS; Raylu, & Oei, 2004) is a 23-item self-report questionnaire which measured thoughts/cognitions experienced while gambling. Each statement was rated on a seven-point Likert scale in relation to the extent the individual agreed with each statement, ranging from

strongly disagree (1) to *strongly agree* (7). The 23-items were divided into five subscales, which align with the five cognitive biases found in problem gamblers. These include: *Perceived Inability to Stop* e.g. “It is difficult to stop gambling as I am so out of control”; *Predictive Control* e.g. “When I have a win once, I will definitely win again”; *Gambling Expectancies* e.g. “Gambling makes me happier”; *Interpretive Bias* e.g. “Relating my losses to bad luck and bad circumstances makes me continue gambling”; and *Illusion of Control* e.g. “Praying helps me win”. The ratings associated with the questions of the subscale were summed and then divided by the number of questions in the subscale, to produce a mean rating. Higher scores are related to more agreement with the cognitive biases associated with gambling. The Gambling Related Cognitions Scale is reported to have excellent internal consistency, Cronbach’s α =0.93 (Raylu & Oei, 2004). This task took approximately 5 minutes to complete (see Appendix B3 for a copy of the questionnaire).

Dependent Measures: Neuropsychological Tasks

The Card Playing Task. The Card Playing Task was used to gauge decision-making, and is a modified version of the task created by Newman, Patterson and Kosson (1987). Participants were presented with a stack of cards on the computer screen and a fictional $500 to play with. To begin the task the participants were instructed to click the mouse on the deck of cards, which would either be followed by a $50 win or loss, which would present at the top of the deck of cards as “You won $50” or “You lost $50”. Participants were instructed they could quit the game at any time. A copy of the instructions is provided in Appendix B4. As they progressed through the trials the sum of money remaining was presented below the deck of cards. There were a total of eight rounds, each consisting of ten trials. After each round of ten cards the computer prompted “do you want to continue?” and the participant had the option to quit or remain playing the game. The task is designed to provide rewards to certain

cards initially; however, as the task progresses the rewards decrease and the losses increase. For example, round one (6 wins; 4 losses) compared to round seven (1 win: 9 losses). The task took approximately 5-7 minutes to complete. The measure produced output of the number of cards played, time to complete, round of cards completed, and the total money remaining when they quit. A similar task has been used in other studies of measuring decision-making (e.g. Gouchiaan et al., 2008).

Connors Continuous Performance Test (CPT) (Connors, 2000). The Connors Continuous Performance Test (CPT) is designed to measure attention, hyperactivity/impulsivity and visual-motor speed and integration. It presented stimuli on a computer screen for 200ms, A, B, F, G, H, J, K, N, T, and V and X. The participant was required to respond to all the letters, except when an 'X' appeared, over a 14-minute period. Variables of interest in this study were the output T-scores of the hit reaction time, variability of this reaction time, commissions (reflecting hyperactivity/impulsivity) and omissions (reflecting inattention). Slowed Hit RT (reaction times) reflects higher T-scores, while fast reaction times reflect lower T-scores. T-scores were based on the respondent's age and gender. A confidence index was also provided (degree of attentional problems). The CPT has demonstrated a good ability to differentiate clinical and non-clinical samples of children with ADHD (Epstein et al., 2004); however, is less able to discriminate in the presence of other attentional disorders, and should not be used to rule in or out adult ADHD (Riccio & Reynolds, 2001).

Emotional Go/no-go tasks. The Emotional Go/No-Go task (Schulz et al., 2007) was developed using E-Prime software and measures behavioral inhibition and emotional processing. The task consisted of 384 stimuli (288 go cues and 96 non-go cues), which were

presented in the centre of the screen for 500ms. The go and no-go cues were integrated into four 192-second blocks (72 go-cues, 24 non-go cues). The measure produced a measure of commissions (impulsivity) reflected when an individual responded to a 'no/go' cue and omissions (inattention) when they fail to respond to a 'go' cue. Higher scores reflect greater hyperactivity and inattention. The emotional stimuli that made up the go/no-go cues consisted of 24 individuals with happy and sad faces (closed mouths) (MacBrain Face Stimulus Set available at www.macbrain.org; see Tottenham et al., 2009) and were counterbalanced for sex, age and ethnicity. The 'go' and 'no-go' cues switched for each of the four blocks, where participants were required to change their responses. The emotional go/no-go task has been found to have moderate construct validity of behavioral inhibition (r = .51-.56). The measure produced mean reaction times to 'go' cues of both happy and sad faces across the task (measure emotional bias/processing) and reaction times of the set-shifting and non-set shifting blocks to happy and sad faces. This task took approximately 15 minutes to complete.

The Stroop Color and Word Test. The Stroop Color and Word Test (Golden, 1975) consisted of three trials, with three different cards presented one at a time, each with five columns and 20 stimuli per card. In each trial the participants had 45 seconds to name/read the stimuli as quickly as possible. The first card presented words (red, blue, green) printed in black ink. The second card presented colour rectangles (red, blue, green). Lastly, words (red, blue, green) were printed in a discordant colour ink, and the participant was required to name the color, rather than reading the word. This measure produced four dependent variables: reading speed, naming speed, words named in different colours, and an interference score, which adjusts for naming speed, to provide a measure of behavioral inhibition. All of the raw scores were converted into T-scores, provided by Golden (1978). Interference scores were

adjusted for age when the participant was 45 years or older. Higher scores reflect better performance on this task. This task took approximately 3 minutes to complete.

Computerized Wisconsin Card Sorting Test (WCST) (Heaton, Chelune, Tally, Kay, & Curtis, 1993). This is a sensitive measure of executive function, involving maintaining a problem-solving strategy throughout the task. The WCST consisted of 128 cards, where the participant had to match a card presented at the bottom of the screen with one of five cards presented above, either matching the colour, design or shape of the cards. The participant was given feedback after each selection whether their response was correct or incorrect. Once the participant was able to match ten cards correctly (e.g. matching the colors) in the trial, the task changed to matching a different category (e.g. matching the shape). This task was designed for ages 6.5-89 years and has been found to be sensitive to frontal lobe damage (Heaton et al., 1993). The variables of interest were number of categories completed, and standard scores of percent preseverative errors, percent total errors and percent conceptual level responses. Higher scores reflect better performance on this task in terms of planning and set-shifting. This test has been found to have moderate test-retest reliability (.37-.72) (Heaton et al., 1993) and took approximately 15-20 minutes to complete.

Dependent variables: Stress and Social Support

Global Assessment of Stress (GARS; Linn, 1985) is a quick self-report measure of stress across different domains. The participants were required to rate their level of pressure/stress experienced in the past week ranging from *none* (0) to *extreme* (10), to each of the eight statements presented (work/job/school; interpersonal relations; changes in relationships; sickness/injury; financial issues; unusual happenings; change or lack of change in daily routines). The GARS has been found to have acceptable test-retest reliability (r = .69

to .92) and moderate construct validity (r = .58-.69) (Linn, 1985). Higher scores on each of the subscales reflect increased levels of pressure/stress in the past week. This questionnaire took approximately 3 minutes to complete (see Appendix C1 for a copy of this questionnaire).

Depression and Anxiety Stress Scales (DASS; Lovibond & Lovibond, 1993) is a 42-item questionnaire which assessed individuals current severity of symptoms relating to depression, anxiety and stress. The participants were instructed to rate each item on the scale as it applied to them over the past week, ranging from *did not apply to me at all* (0) to *applied to me very much, or most of the time* (3). An example of a statement from the *depression* subscale is, "I couldn't seem to experience any positive feeling at all". An example of a statement from the *anxiety* subscale is "I had a feeling of faintness". A statement from the *stress* scale is "I found myself getting upset by quite trivial things". The DASS provided a total score of the three subscales (depression, anxiety and stress). The higher scores reflect greater impairment, and there were cutoff scores to indicate the severity of impairment on these subscales. The DASS has good internal consistency within each subscale (Cronbach's α= 0.84-0.91) and excellent psychometric properties (Lovibond & Lovibond, 1995; Brown et al., 1997; Antony et al., 1998) (see a copy of this measure in Appendix C2).

Social Support Questionnaire (short form) (Sarason, Sarason, Shearin, & Pierce, 1987). This 6-item short questionnaire assessed both quantitative and qualitative elements of an individual's social support. Participants were instructed to list the number of people as it applied for each question. The six questions assess who an individual could count on to distract them from their worries; count on to help them feel more relaxed when under pressure; who accepts them totally including their best and worst points; who cares about

them regardless of what is going on; who helps them feel better when they are feeling generally down in the dumps, and who they can count on to console them when they are very upset. Each question was scored through summing the number of people listed in each subscale. Participants took 5 minutes to complete the task. The Social Support Questionnaire is reported to have good internal consistency (Cronbach's α = 0.90-0.93) (Sarason et al., 1987) (see Appendix C3 for a copy of this measure).

Procedure

The study received ethical approval from the University of Canterbury Ethics Committee and the Health and Disability Ethics Committee (Upper South A Regional Ethics Committee). Questionnaire packages were sent to the participants prior to their interview and subsequent testing. The questionnaires included the; Social Support Questionnaire, Depression and Anxiety Stress Scale (DASS), Global Assessment of Recent Stress (GARS), History Questionnaire, Gambling Motivations Scale (GMS), Gambling Related Cognitions Scale (GRCS), South Oaks Gambling Screen (SOGS), CAARS self and observer reports, and for the ADHD participants the history CAADID booklet, Part I.

All participants were tested individually in a quiet laboratory within the Psychology Department at the University of Canterbury. Firstly, participants were administered the Structured Clinical Interview for Axis I Disorders (SCID). ADHD participants then completed an additional interview (CAADID), which took approximately 2 hours total. All ADHD interviews were reviewed with a senior clinical psychologist. Once an ADHD diagnosis had been established in the ADHD participants, they were invited to return to the University for testing on the neuropsychological tasks.

Each participant was administered in the same order the; Wisconsin Card Sorting Test (WCST), Block design and Vocabulary subtests from the Wechsler Adult Intelligence

Scale (WAIS), Emotional Go/No-Go, Stroop Task, Continuous Performance Test (CPT) and lastly the Card Playing Task. Participants were encouraged to take breaks as required. All participants followed the same instructions for all tasks, which were read out by the researcher. Testing time generally took 1.5-2 hours for each participant.

Seven (23.3%) of the ADHD participants were on methylphenidate and were asked to not take it on the day of testing, which was confirmed prior to testing. Thirteen (43.3%) of the ADHD participants were taking antidepressant medications at the time of testing (16.7% Venlafaxine, 6.7% Citalopram, 13.3% Fluoxetine, 3.3% Fluxotine and Nortriptoline, 3.3% Dothiepin, 3.3% Lithium). In the control group only one (3.6%) participant was on the antidepressant Fluoxetine.

Results

Statistical Analyses

Results were analysed using the Statistical Package for the Social Sciences (SPSS) - Windows version 17. Multivariate (MANOVA) and univariate (ANOVA) analyses of variance were used to examine group differences. Wilk's Lambda (λ) was used as the overall test of significance, if the overall omnibus was significant ($p < .05$), subsequent univariate analyses were interpreted. Partial eta-squared (η^2) was calculated as a measure of experimental effect sizes, and were operationalised as small (.01), medium (.06), and large (.14) (Stevens, 1992).

Logarithmic transformations were applied to variables that had severely skewed distributions to better approximate a normal distribution; for purposes of interpretation raw scores were presented, however, it was noted in the analyses when these transformations were used. Variables that could not be successfully transformed to a normal distribution, particularly with smaller sample sizes, were examined in separate analyses using non-

parametric techniques (Mann-Whitney U tests). Chi-square analyses were used for comparisons on categorical variables. Correlational analyses were used to examine the relationship of variables of interest in exploratory analyses within the ADHD group.

Sample Characteristics

Univariate analyses of variance (ANOVAs) indicated that the groups were equivalent in age, (F (1, 56) = 2.12, p = .151) SES estimates (F (1, 56) = .006, p = .941), estimated IQ (F (1, 56) = .926, p = .340), subtests of vocabulary (F (1, 56) = 1.28, p = .268), and block design (F (1, 56) = .285, p = .596) (see Table 1). Chi-square tests determined that there were no group differences in ethnicity (χ^2 (4, N = 58) = 2.69, p = .441), sex distribution (χ^2 (1, N = 58) = .064, p = .80), marital status (χ^2 (4, N = 58) = 3.35, p = .34), home situation (χ^2 (7, N = 58) = 10.29, p = .113), education (χ^2 (7, N = 58) = 8.80, p = .267) and income (χ^2 (6, N = 58) = 8.97, p = .175) (see Table 1). However, there were significant differences in employment (χ^2 (4, N = 58) = 9.31, p = .025); thirteen (46.4%) of the control group were students compared to seven (23.3%) of the ADHD group and six (20%) ADHD participants reported being either unemployed/sickness benefit, whereas no participants from the control group reported this.

Sixteen (53.3%) of the ADHD participants reported previous behavioural difficulties at school, while only four (14.3%) from the control group reported this (χ^2 (2, N = 58) = 9.77, p = .002). However, there were no differences in the rates of being excluded from school, with five (6.7%) of the ADHD group reporting this compared to one (3.6%) control participant (χ^2 (1, N = 58) = 2.68, p = .102). There were no significant differences in the rates of head injuries reported (χ^2 (2, N = 58) = 2.06, p = .152).

Table 1

Sociodemographic Characteristics and IQ by Group: Percent (%) and Number (n)

Characteristic/ Variable	ADHD (*N* = 30)		Control (*N* = 28)	
	n	%	*n*	%
Sex				
Male	16	53.3	14	50
Female	14	46.7	14	50
Age (years) [a]	35.25	13.25	30.48	11.54
Estimated SES [a]	56.80	38.14	57.30	33.22
Estimated FIQ [a]	115.80	16.09	119.86	15.99
Vocabulary SS [a]	12.43	3.51	13.36	2.61
Block Design SS [a]	13.03	2.88	13.50	3.75
NZ European	22	73.3	20	71.4
Maori	0	0	1	3.6
Asian	2	6.7	4	14.3
Other	6	20	3	10.7
Home Situation				
Dependent children	7	23.3	9	32.1
Not living with children	4	13.3	0	0
Flatting with others	5	16.7	8	28.6
Living/supported by parents	6	20	9	32.1
Living alone	4	13.3	1	3.6
Support parents or relatives	1	3.3	1	3.6
Live just with partner/wife	3	10	0	0
Education				
No school qualifications	3	10	0	0
Year 11 in 1 + subject	5	16.7	1	3.6
Year 12 in 1 + subject	4	13.3	2	7.1
University entrance	4	13.3	9	32.1
Post-secondary	5	16.7	6	21.4
University undergraduate degree	5	16.7	4	14.3

University postgraduate degree	2	6.7	3	10.7
Overseas university qualification	2	6.7	3	10.7
Marital status				
Married/cohabitating	12	40	11	39.3
Divorced/separated	3	10	0	0
Dating	1	3.3	2	7.1
Single	14	46.7	15	53.6
Employment				
Working	16	53.3	12	42.9
Housewife	1	3.3	3	10.7
Student	7	23.3	13	46.4
Unemployed/sickness benefit	6	20	0	0
Income				
< $20,000	7	23.3	5	17.9
$20,000-$30,000	6	20	3	10.7
$30,000-$40,000	5	16.7	2	7.1
$40,000-$50,000	4	13.3	4	14.3
$50,000-$60,000	0	0	6	21.4
$60,000-$70,000	1	3.3	2	7.1
> $70,000	7	23.3	6	21.4

Note. SES = socioeconomic status; WAIS = Wechsler Adult Intelligence Scale-III; SS = standard scores. [a]Means and standard deviations associated with univariate analyses.

As seen in Table 2, there were significant differences between the groups in the frequency of mood disorders, with seven (23.3%) of the ADHD sample currently meeting criteria for a Major Depressive Episode (MDE), compared to none in the control group (χ^2 (1, N = 58) = 7.43, p = .006). Twenty-three (76.7%) of the ADHD sample also met past criteria for Major Depressive Episode (MDE), compared with twelve (42.9%) of the control group (χ^2 (1, N = 58) = 6.92, p = .009). Five (16.7%) ADHD participants met past criteria for a

diagnosis of Dysthymia, whereas none from the control reported this (χ^2 (1, N = 58) = 5.11, p = .024).

Ten (33.3%) of the ADHD sample also met criteria for current social phobia compared to three (10.7%) of the control group (χ^2 (1, N = 58) = 4.26, p = .039). Seven (23.3%) of the ADHD sample met past diagnostic criteria for drug dependence, while none of the control group did (χ^2 (1, N = 58) = 7.43, p = .006). Twelve (40%) of the ADHD group met past criteria of alcohol abuse, compared to three (10.7%) participants in the control group (χ^2 (1, N = 58) = 6.48, p = .011) and ten (33.3%) ADHD participants met past criteria for alcohol dependence compared to two (7.1%) participants in the control group (χ^2 (1, N = 58) = 6.05, p = .014). There were no group differences in terms of suicidal thoughts (χ^2 (1, N = 58) = .217, p = .641), suicidal plans (χ^2 (1, N = 58) = 1.93, p = .164), suicide attempts (χ^2 (1, N = 58) = 1.75, p = .186) and self harm (χ^2, (1, N = 58) = 1.93, p = .164) between the ADHD and control groups.

Table 2

Psychiatric Diagnoses by Group: Number (n) and Percentage (%) Plus Chi-Square Statistic (χ^2)

Comorbid Diagnosis	ADHD (N = 30)		Control (N = 28)		
	n	%	*n*	%	χ^2 (1, N = 58)
MDE (C)	7	23.3	0	0	7.43**
MDE (P)	23	76.7	12	42.9	6.92**
Dysthymia (C)	2	6.7	0	0	1.93
Dysthymia (P)	5	16.7	0	0	5.11*
Phobia (C)	2	6.7	1	3.3	.283
Phobia (P)	2	6.7	0	0	1.93
PTSD (C)	3	10.0	0	0	2.95
Social phobia (C)	10	33.3	3	10.7	4.26*

Social phobia (P)	4	13.3	1	3.6	1.75
GAD (C)	2	6.7	0	0	1.93
GAD (P)	2	6.7	0	0	1.93
Drug abuse (C)	2	6.7	0	0	1.93
Drug abuse (P)	8	26.7	2	7.1	3.87
Drug dependence (P)	7	23.3	0	0	7.43**
Alcohol abuse (C)	4	13.3	1	3.6	1.75
Alcohol abuse (P)	12	40.0	3	10.7	6.48*
Alcohol dependence (C)	4	13.3	1	3.6	1.75
Alcohol dependence (P)	10	33.3	2	7.1	6.05*

Note. Only those with two or more diagnoses were included in these analyses. ADHD = Attention-Deficit/Hyperactivity Disorder; MDE = Major Depressive Episode; PTSD = Posttraumatic Stress Disorder; GAD = Generalised Anxiety Disorder; C = met current diagnosis; P = met past diagnosis.
*$p < .05$, **$p < .01$, ***$p < .001$.

As expected there were group differences on the CAARS scales between the control and ADHD groups (see Table 3) on the self-reported frequencies of inattentive symptoms (F (1, 56) = 269.03, $p < .001$) hyperactive/impulsive symptoms (F (1, 56) = 46.03, $p < .001$), and observer reports of the frequency of inattentive symptoms (F (1, 56) = 80.90, $p < .001$) and hyperactive/impulsive symptoms (F (1, 56) = 28.22, $p < .001$). As shown in Table 3 there was a higher average of inattentive symptoms reported in childhood and adulthood compared to hyperactive/impulsive symptoms within the ADHD group.

Table 3

Means (M) and Standard Deviations (SD) of ADHD Symptoms, Along with Symptom Severity plus Number and Percent of ADHD Subtypes.

Variable	ADHD (N = 30)		Control (N = 28)	
	M	*SD*	*M*	SD
# of symptoms (CAADID)				
Inattentive (Child)	6.47	2.53	N/A	N/A
Inattentive (Adult)	7.30	1.91	N/A	N/A
H/I (Child)	5.00	3.30	N/A	N/A
H/I (Adult)	5.20	2.89	N/A	N/A
# of subtypes (CAADID)				
Predominantly inattentive[a]	14	46.7	N/A	N/A
Hyperactive/impulsive[a]	4	13.3	N/A	N/A
Combined [a]	12	40	N/A	N/A
CAARS - S (T-scores)				
DSM-IV Inattentive***	83.07	8.32	47.61	8.12
DSM-IV H/I***	64.27	14.90	42.54	8.30
CAARS - O (T-scores)				
DSM-IV inattentive***	68.57	10.01	46.86	8.21
DSM-IV H/I***	60.73	14.42	45.14	5.94

Note. CAADID = Conners' Adult ADHD Diagnostic Interview for DSM-IV; CAARS-S = Conners Adult ADHD Rating Scale-Self-report; CAARS-O = Conners Adult ADHD Rating Scale-Observer-report; H/I = hyperactive/impulsive symptoms; # = number. [a]Number and percent.

*p < .05, **p < .01, ***p < .001

Gambling Variables across the ADHD and Control Groups

Fifty-two of the fifty-eight participants surveyed for gambling (26 ADHD, 26 controls) reported ever gambling on an activity in a lifetime. Of those who had ever gambled, there were significant differences in the range of gambling problems between the groups. Twenty (76.9%) of the control group had no problems with gambling in a lifetime, compared to eleven (42.3%) of the ADHD group. In addition, twelve (46.2%) ADHD participants and six (23.1%) controls were classified as having some problems with gambling (i.e. scores between 1-2; *Note* -one ADHD participant had a score of 3). Three (11.5%) ADHD participants met cut-off criteria for probable pathological gambling in a lifetime (i.e. scores greater than 5; Scores in our sample were: 6, 16 & 19), whereas none of the control participants met this criteria (χ^2 (2, N = 52) = 7.61, p = .022).

Four (15.4%) of the control group, compared to one (3.3%) participant with ADHD reported that someone in their family ever had a gambling problem (e.g. mother, father, siblings, another relative). However, five (19.2%) of the ADHD group reported that a friend or someone important in their lives had ever had a gambling problem, whereas none of the control group reported this (χ^2 (2, N = 52) = 6.89, p = .032).

Six (23.1%) of the ADHD group reported they had ever felt guilty about the way they gamble compared to one (3.8%) participant from the control group (χ^2 (1, N = 52) = 4.13, p = .042). Four (15.4%) of the ADHD participants reported that they have or ever felt they had a problem with gambling compared to none of the control group (χ^2 (1, N = 52) = 4.33, p = .037).

In terms of problem gambling behaviour reported in a lifetime, as defined by the South Oaks Gambling Screen (see Table 4) we found a significant difference, with five (19.2%) of the ADHD participants reporting they had ever claimed to be winning money

gambling, when, in fact they were losing (less than half the time, or most of the time they lost), whereas none of the control group reported this (χ^2 (1, N = 52) = 5.53, p = .019).

Table 4

Problem Gambling Behaviour Reported in a Lifetime by Group: Number (n) and Percentage (%)

Problem Gambling behaviour (SOGS)	ADHD (N = 26)		Control (N = 26)	
	n	%	*n*	%
Ever gone back another day to win back money lost	3	11.5	0	0
Ever claimed to be winning when they were not	5	19.2*	0	0
Ever gamble more than intended to	11	42.3	6	23.1
Criticized/told had a problem with gambling	2	7.7	2	7.7
Ever felt would like to stop gambling but couldn't	3	11.5	0	0
Attempted to hide signs of gambling from spouse	2	7.7	0	0
Money arguments centred on gambling	2	7.7	0	0
Borrowed money for gambling	2	7.7	0	0
Lost time from work/school due to gambling	2	7.7	0	0

Note. χ^2 analyses. SOGS = South Oaks Gambling Screen.
*p < .05, ** p < .01

A near significant difference was found between the ADHD and control group in the forms of gambling played in a lifetime, where 18 (69.2%) of the control group reported playing lottery, compared to 11 (42.3%) of the ADHD participants (χ^2 (1, N = 52) = 3.82, p = .051). In contrast, 22 (84.6%) of the ADHD group reported they had ever gambled at the casino in a lifetime compared to 15 (57.7%) of the control group (χ^2 (1, N = 52) = 4.59, p = .032) (see Table 5). Due to small sample sizes, we did not include in the analyses those who had played once a week or more in a lifetime, however, three (10%) of the ADHD group reported playing lottery once a week or more compared to two (7.1%) from the control group.

In addition, two (6.7%) of the ADHD participants reported ever betting on animals weekly, and one ADHD participant reported (3.3%) ever gambling weekly on sport, at the casino and on poker machines.

Table 5

Forms of Gambling Played in a Lifetime by Group: Number (n) and Percentage (%)

Forms of Gambling (SOGS)	ADHD (N = 26)		Control (N = 26)	
	n	%	*n*	%
Played cards for money	9	34.6	10	38.5
Bet on animals	12	46.2	11	42.3
Bet on sports	8	30.8	8	30.8
Dice games for money	6	23.1	4	15.4
Casino gambling*	22	84.6	15	57.7
Lotteries*	11	42.3	18	69.2
Bingo	6	23.1	5	19.2
Stock/commodities market	5	19.2	1	3.80
Slot/gaming machines	18	69.2	14	53.8
Game of skill for money	5	19.2	4	15.4

Note. χ^2 analyses. SOGS = South Oaks Gambling Screen.

*$p < .05$

The ADHD group reported greater motivations for gambling relating to *Identified Regulation* (e.g. “Because it’s the best way to relax completely”), compared to the control group (U = 257.00, p = .045) (see Table 6). As can be seen in Table 7 the ADHD group reported greater cognitive biases of *Perceived Inability to Stop* (U = 239.00, p = .017), and a near significant difference in *Predictive Control* (e.g. “when I win I will defiantly win again”) (U = 239.50, p = .054).

Table 6

Ratings of Motivations for Gambling by Group: Means (M) and Standard Deviations (SD)

Gambling Motivation (GMS)	ADHD (N = 26)		Control (N = 26)	
	M	*SD*	*M*	*SD*
(IM) Stimulation/Excitement	2.39	1.91	1.97	1.12
(IM) Knowledge	1.46	.740	1.79	1.34
(IM) Accomplishment	1.31	.630	1.14	1.09
(EM) External Regulation	2.61	2.14	2.21	1.85
(EM) Introjected Regulation	1.44	.830	1.25	.690
(EM) Identified Regulation*	1.63	1.30	1.09	.270
Amotivation	2.62	2.20	1.70	.990

Note. Mann-U Whitney test. GMS = Gambling Motivations Scale; (IM) = Internal Motivations; (EM) = External Motivations.
*$p < .05$.

Table 7

Ratings of Cognitions Experienced While Gambling by Group: Means (M) and Standard Deviations (SD)

Gambling Cognition (GRCS)	ADHD (N = 26)		Control (N = 26)	
	M	*SD*	*M*	*SD*
Interpretive Bias	1.65	.975	1.62	1.19
Perceived Inability to Stop*	1.72	1.49	1.06	.267
Predictive Control †	1.60	.743	1.44	.932
Illusion of Control	1.32	.812	1.29	.608
Gambling Expectancies	2.03	1.37	1.63	1.15

Note. Mann-U Whitney test. GRCS = Gambling Related Cognitions Scale. †a near significant difference of $p = .054$.
*$p < .05$.

Neuropsychological Functioning and Social Support across Gambling Severity in the ADHD Group

Further analyses were conducted to discover if neuropsychological functioning differentiated those individuals with ADHD who had some problems with gambling (SOGS =1-3) (n = 12) from those with no reported problems with gambling (SOGS = 0) (n = 11) (see Table 8). Due to small sample sizes we could not explore this relationship in the pathological gamblers (n = 3); however, means and standard deviations were presented in the text where it provided potentially useful information.

There were no significant differences in estimated IQ, Block Design or Vocabulary subtests; however, a trend of lower scores was found in those with no problems with gambling in estimated IQ (F (1, 21) = 2.98, p = .099, η^2 = .124) and Block Design (F (1, 21) = 2.78, p = .110, η^2 = .117). It is worth noting the pathological gamblers also had lower scores on the Vocabulary subtest (M = 10.00; SD = 4.25); Block Design (M = 10.50; SD = .707), and estimated IQ (M = 101.50; SD = 10.61).

A Mann-U Whitney test revealed there were significant differences on the Wisconsin Card Sorting test (WCST), where those with some problems with gambling performed better; being able to complete more categories of the task (U = 33.50, p = .014), have a better conceptual response (U = 20.00, p = .004) and make less preservative errors (U = 32.50 p = .039) and total errors (U = 26.00, p = .014), compared to those with no problems with gambling (see Table 8). Those with pathological gambling (n = 3) had similar performance to those with no problems with gambling, on total errors made (M = 92.33, SD = 13.42); perseverate errors (M = 91.67; SD = 12.67); conceptual responses (M = 96.7; SD = 13.80); and categories completed (M = 5.00; SD = 1.73).

A Mann-Whitney U test revealed no significant differences on the Card Playing Task; however, there was a trend of those with some problems with gambling having more money remaining than those with some problems with gambling (U = 38.00, p = .082). It is worth

noting those with pathological gambling had less money remaining (*M* = $133.33; *SD* = 737.11), spent more time on the task (*M* = 124.00 ms; *SD* = 76.54), and completed more rounds (*M* = 4.67; *SD* = 3.06).

There were no significant differences in a MANOVA of omissions and commissions made on the Emotional Go/No-Go (Wilks' λ = .22, F (2, 20) = 2.87, p = .080, η^2 = .223). There were no significant differences in reaction times to happy and sad faces on the Emotional Go/No-Go (Wilks' λ = .822, F (6, 42) = 1.51, p = .198, η^2 = .178).

There was a near significant difference on the Stroop Task (Wilks λ = .612, F (4, 18) = 2.850, p = .054, η^2 =.388). Univariate tests showed those with no problems with gambling were slower at naming colour-words printed in different colours (F (1, 21) = 6.99, p = .015); however, they did not significantly differ on the interference score (which adjusts the naming speed). There were no significant differences on the Continuous Performance Test (CPT) (Wilks λ = .837, F (5, 17) = .661, p = .658, η^2 =.163).

Table 8

Neuropsychological Functioning by Gambling Severity in the ADHD Group: Means (M), Standard Deviations (SD) plus F-statistic and Eta-Squared (η^2)

Variable	No Problems (*N* = 11)		Some Problems (*N* = 12)			
	M	*SD*	*M*	*SD*	*F* (1, 22)	η^2
Estimated IQ	111.09	16.57	122.58	15.35	2.98	.124
Vocabulary (SS)	11.73	3.79	13.67	3.23	1.76	.077
Block design (SS)	12.09	2.73	14.17	3.19	2.78	.117
WCST (SS)						
# Categories completed [a]	4.55	1.81	5.92	.2887	33.50 **	N/A

% Conceptual response [a]	87.18	14.45	105.00	9.70	20.00 **	N/A
% Perseverative errors [a]	92.55	17.76	112.92	19.70	32.50 *	N/A
Emotional Go/No-Go						
# Omissions	9.81	6.98	4.58	6.43	3.50	.056
# Commissions	28.18	13.45	17.41	11.83	4.17	.030
Happy RT (ms)	440.75	62.04	424.26	73.23	.336	.016
Sad RT (ms)	453.17	83.72	469.46	66.35	.270	.015
(S-S) Happy RT (ms)	434.83	63.98	418.14	71.96	.343	.016
(N-S) Happy RT (ms)	499.46	156.89	544.18	121.34	.591	.027
(S-S) Sad RT (ms)	477.33	212.60	504.35	174.96	.112	.005
(N-S) Sad RT (ms)	451.34	78.08	464.22	64.32	.188	.009
Card Playing Task						
Time (s) [a]	108.73	70.39	79.67	41.53	55.00	N/A
Money [a]	181.81	592.99	475.00	480.77	38.00	N/A
# Cards [a]	44.36	30.41	29.50	24.49	50.00	N/A
# Rounds [a]	4.181	2.96	3.25	2.38	54.50	N/A
CPT (T-scores)						
Omissions	54.14	9.50	49.03	9.01	1.33	.062
Commissions	58.30	13.62	51.76	9.93	2.85	.125
Confidence index	53.52	23.94	46.58	24.61	.449	.022
Variability	55.44	11.35	54.62	7.50	.040	.002
Hit RT	48.55	13.53	52.10	8.95	.528	.026
Stroop (T-scores)						
Word ь	43.36	6.85	41.83	6.56	.288	.014
Colour ь	37.91	7.30	43.58	8.63	2.30	.099
CW ь	45.09	9.32	55.33	9.95	6.99*	.250
Interference ь	52.27	8.67	57.75	6.99	2.96	.124

Note. (SS) = standard scores; (s) = seconds; (ms) = milliseconds; (S-S) = set-shifting; (N-S) = non set-shifting; CPT = Continuous Performance Test; RT = reaction time. [a]Mann-Whitney U test statistic. ь Logarithmic transformations conducted on variables.

*$p < .05$, **$p < .01$, ***$p < .001$.

There was a significant difference of those with no problems with gambling having more people to count on to help them better when they are feeling generally 'down in the dumps' (U = 34.50, p = .047) and a trend of having less people to help distract them from their worries when they are stressed (U = 39.00, p = .089), and help console them when they are very upset (U = 38.50, p = .080) (see corresponding means and standard deviations in Table 9).

It should be noted, the pathological gamblers also had a limited number of people to help distract them from their worries (M =1.00; SD = 1.00); help them when they feel down in the dumps (M = 1.00; SD =1.00), and people to help console them when they are very upset (M = 1.00; SD = 1.00).

Table 9

Social Support by Gambling Severity in the ADHD Group: Means (M) and Standard Deviations (SD) plus Mann-U Whitney Test Statistic (U).

Type of Social Support	No problems (N = 11)		Some Problems (N = 12)		
	M	*SD*	*M*	*SD*	*U*
Distract from worries when stressed	5.00	4.82	1.75	1.54	39.00
Help relax when tense	4.18	4.56	1.83	1.64	44.50
Accepts totally	9.72	20.14	2.58	2.74	40.00
Care about regardless	5.36	5.98	1.07	.9847	42.00
Help feel better when 'down in dumps'	4.36	3.38	2.08	2.10	34.50*
Help console when very upset	4.90	5.66	1.83	1.34	38.50

Note: Mann-U Whitney test

*p < .05

Exploratory Analyses: Other Differences across Gambling Severity in the ADHD group

The gender distribution in the ADHD with no problems with gambling was four (36.4%) males and seven (63.7%) females. However, the gender distribution in those with some problems with gambling was seven (66.7%) males and four (33.3%) females. These differences were not significant (χ^2 (1, N = 23) = 2.112, p = .146); however, indicate there is a trend of more males in the group with some problems with gambling. There was one female and two males, in the group of probable pathological gamblers.

Those with no problems with gambling had a greater frequency of Combined (45.5%; n = 5) and Hyperactive/Impulsive (18.2%; n = 2) Types, compared to Predominately Inattentive Type (36.4%; n = 4). However, those with some problems with gambling had a greater frequency of Predominately Inattentive Type (66.7%; n = 8) compared to the frequencies of Combined Type (33.3%; n = 4). Those with no problems with gambling (M = 65.91, SD = 14.46) had greater clinically significant levels of hyperactive/impulsive symptoms on the observer report of the CAARS, compared to those with some problems with gambling (M = 51.05, SD = 10.00), (F (1, 21) = 8.31, p = .009, η^2 = .284). This indicates a higher number of hyperactive/impulsive symptoms in those with no problems with gambling.

Next, as seen in Table 10 we explored whether rates of psychiatric disorders differed between the groups. There were no significant differences, but slightly higher rates of dysthymia, alcohol abuse and dependence in three (25%) participants with some problems with gambling. It should be noted that two of the probable pathological gamblers met current criteria for PTSD, one met past criteria. Two of the pathological gamblers also met past criteria for substance dependence.

Table 10

Psychiatric Diagnoses by Gambling Severity in the ADHD Group: Number (n) and Percentage (%) plus Chi-Square Statistic (χ^2)

Comorbid Diagnosis	No problems (N = 11)		Some problems (N = 12)		
	n	%	*n*	%	χ^2 (1, N = 23)
MDE (P)	2	18.2	2	16.7	.009
MDE (P)	8	72.7	11	91.7	1.43
Dysthymia (P)	0	0	3	25.0	2.90
Social phobia (C)	3	27.3	6	50.0	1.25
Social phobia (P)	2	18.2	2	16.7	.009
Drug abuse (P)	2	18.2	2	16.7	.009
Drug dependence (P)	2	18.2	2	16.7	.009
Alcohol abuse (C)	0	0	3	25.0	3.16
Alcohol abuse (P)	4	36.4	5	41.7	.068
Alcohol dependence (C)	0	0	3	25.0	3.16
Alcohol dependence (P)	2	27.3	4	33.3	.100

Note. Only those with two or more diagnoses were included in these analyses. (MDE) = Major Depressive Episode; (C) = met current criteria for a diagnosis; (P) = met past criteria for a diagnosis.

There were significant differences across the gambling groups in the ADHD sample in forms of gambling ever played in a lifetime (see Table 11). Six (50%) of those with some problems with gambling in a lifetime had ever gambled with cards for money (χ^2 (1, N = 23) = 4.54, p = .033) and gambled on sports (χ^2 (1, N = 23) = 4.54, p = .033), compared to one (9.1%) participant with no problems with gambling. Five (41.7%) of those with some problems with gambling had ever played the commodities, whereas none of those with no problems with gambling reported this (χ^2 (1, N = 23) = 5.86, p = .016).

Table 11

Forms of Gambling Reported by Gambling Severity in the ADHD Group: Number (n) and Percentage (%) plus Chi-Square Statistic (χ^2)

Forms of gambling (SOGS)	No problems (N = 11)		Some problems (N = 12)		
	n	%	*n*	%	χ^2 (1, N = 23)
Played cards for money*	1	9.1	6	50.0	4.54
Bet on sports*	1	9.1	6	50.0	4.54
Bet on animals	5	45.5	5	41.7	.034
Dice games for money	2	18.2	3	25.0	.157
Casino gambling	9	81.8	11	91.7	.491
Lotteries	4	36.4	5	41.7	.068
Bingo	1	9.1	4	33.3	1.98
Stock/commodities market*	0	0	5	41.7	5.86
Slot/machine games	6	54.5	9	75.0	1.06
Game of skill for money	1	9.1	2	16.7	.290

Note. χ^2 analyses. SOGS = South Oaks Gambling Screen.
*$p < .05$

There were significantly greater motivations of gambling for *External Regulation* (e.g. rewards/money) (U = 32.50, p = .023) in those with some problems with gambling. Trends were also apparent for gambling more for *Introjected Regulation* (e.g. help relax/release tension) (U = 40.50, p = .054) and for *Accomplishment* (e.g. feeling of efficacy of playing their favourite game) (U = 4 1.00, p = .059) (see Means and Standard deviations in Table 12). Cognitive biases experienced during gambling were greater in those with some problems with gambling, with a near significant difference related to *Gambling Expectancies* (e.g. gambling with make me happier) (U = 36.50, p = .054). There were no other significant differences in cognitions experienced while gambling between the groups (see Table 13).

Table 12

Ratings of Motivations for Gambling by Gambling Severity in the ADHD Group: Means (M) and Standard Deviations (SD)

Gambling Motivation (GMS)	No Problems (N = 11)		Some Problems (N = 12)	
	M	*SD*	*M*	*SD*
(IM) Stimulation	1.55	.9540	2.04	1.032
(IM) Knowledge	1.20	.4585	1.65	.9074
(IM) Accomplishment†	1.14	.4522	1.42	.7334
(EM) External regulation*	1.34	.8535	2.96	2.233
(EM) Introjected regulation†	1.20	.6784	1.65	1.002
(EM) Identified regulation	1.05	.1011	1.39	.7265
Amotivation	1.91	2.022	2.52	2.057

Note. Mann-Whitney U tests. GMS = Gambling Motivations Scale; (IM) = Internal Motivations; (EM) = External Motivations. †near significant differences (p = .059; p =.054).
*p < 05.

Table 13

Ratings of Cognitions Experienced while Gambling by Gambling Severity in the ADHD Group: Means (M) and Standard Deviations (SD)

Gambling Cognition (GRCS)	No Problems (N = 11)		Some Problems (N = 12)	
	M	*SD*	*M*	*SD*
Interpretive Bias	1.29	.9001	1.67	.8616
Inability to Stop	1.14	.2696	1.35	.8096
Predictive Control	1.55	.8314	1.64	.7648
Illusion of Control	1.36	.8012	1.33	.9434
Gambling Expectancies †	1.48	.9647	2.10	1.410

Note. Mann-Whitney U tests. GRCS = Gambling Related Cognitions Scale. †Near significant difference (p = .054).
*p < .05.

Neuropsychological and Psychosocial Functioning across the ADHD and Control Groups

Table 14 presents the descriptive statistics of the neuropsychological variables across the ADHD and control groups. Contrary to hypotheses there were no significant differences on the Wisconsin Card Sorting Test (WCST) (Wilks $\lambda = .928$, F (4, 53) = 1.02, $p = .404$, $\eta^2 = .072$).

A multivariate analysis of variance (MANOVA) testing group differences on the Continuous Performance Test (CPT) was significant (Wilks $\lambda = .784$, F (5, 52) = 2.87, $p = .023$, $\eta^2 = .216$). As predicted, ADHD participants overall matched a greater clinical profile on the Confidence Index (F (1, 56) = 4.54, $p = .037$, $\eta^2 = .075$), had slower reaction times (F (1, 56) = 5.18, $p = .027$, $\eta^2 = .085$) and greater variability in their reaction times (F (1, 56) = 12.30, $p = .001$).

A MANOVA of the Emotional Go/No-Go omission and commission rates was not significant (Wilks' $\lambda = .994$, F (2, 55) = .167, $p = .846$). However, a MANOVA of reaction times to happy and sad faces across the conditions was significant (Wilks $\lambda = .77$, F (6, 51) = 2.54, $p = .031$, $\eta^2 = .230$). Subsequent univariate tests revealed a near significance difference of reaction times to sad faces being slower in the ADHD group (F (1, 56) = 3.67, $p = .060$, $\eta^2 = .062$), and a significant difference in reaction times to sad faces during the non-set shifting component, which was slower in the ADHD participants (F (1, 56) = 6.96, $p = .011$, $\eta^2 = .11$).

No significant differences were found on the Card Playing Task (Wilks $\lambda = .934$, F (4, 53) = .936, $p = .450$, $\eta^2 = .066$). In addition, there were no significant differences on the variables in the Stroop Task (Wilks $\lambda = .94$, F (4, 53) = .912, $p = .464$, $\eta^2 = .064$).

Table 14

Neuropsychological Functioning by Groups: Means (M) and Standard Deviations (SD) plus F-statistic and Eta-Squared (η^2).

Variable	ADHD (*N* = 30)		Control (*N* = 28)			
	M	*SD*	*M*	*SD*	*F* (1, 56)	η^2
WCST (SS)						
#Categories completed	5.33	1.35	7.07	8.17	1.32	.023
% Conceptual response	97.87	14.77	103.46	13.52	2.26	.039
% Perseverative errors	102.77	21.45	105.25	13.32	.276	.005
% Total errors	99	14.05	102.89	13.58	1.15	.020
Emotional Go-No/Go						
# Omission	6.27	6.64	6.46	5.83	.014	.000
# Commission	20.97	12.27	19.46	12.69	.210	.004
Happy RT (ms)	439.48	66.76	422.05	46.12	1.32	.032
Sad RT (ms)	466.50	71.36	434.41	53.86	3.67	.062
Happy non-shifting (ms)	433.45	66.54	417.25	46.31	1.43	.020
Happy set-shifting (ms)	529.71	142.68	511.76	131.42	.248	.004
Sad non-shifting (ms)	461.49	67.20	422.11	42.78	6.96**	.111
Sad shifting (ms)	519.38	183.42	492.69	130.27	.403	.007
Card Playing Task						
Time (s)	100.16	61.72	94.96	62.77	.101	.002
Money remaining	313.33	538.03	380.38	406.96	.283	.005
# of cards played	37.80	27.39	30.12	23.89	1.29	.023
# of rounds completed	3.90	2.64	3.32	2.36	.770	.014
CPT (T-scores)						
Omissions	50.64	8.84	48.32	6.73	1.24	.022
Commissions	54.83	12.80	53.38	8.91	.245	.004
Confidence index	52.91	24.37	40.47	19.64	4.54*	.075
Variability RT	55.70	9.77	47.22	8.56	12.30***	.180
Hit Reaction Time	49.73	13.88	43.22	6.27	5.18*	.085

Stroop (T-scores)						
Word	43.33	6.66	44.39	6.56	.372	.007
Colour	41.93	8.50	46.71	8.50	3.22	.054
Colour/Word	50.87	10.36	52.43	10.09	.338	.006
Interference	55.73	7.99	56.32	7.12	.087	.002

Note. Univariate analyses. (SS) = Standard Scores; WCST = Wisconsin Card Sorting Test; CPT = Continuous Performance Test; RT = reaction times; (s) = seconds; (ms) = milliseconds; % = percentage; # = number.
*p < .05, **p < .01, ***p < .001.

When we explored the relationship of the severity of ADHD symptoms in relation to the Card Playing Task (e.g. decision-making) in the ADHD sample (N = 30), we found increases in *self reported* DSM-IV inattentive symptoms was related to having more money remaining on the Card Playing Task (r = .374, n = 30, p = .042); however, there was a pattern of increased levels of hyperactivity/impulsivity on the *observer report* relating to having less money remaining (r = -.345, n = 30, p = .062). We then explored this trend in the ADHD subtypes (combined and inattentive). In the Combined Type, higher levels of *observer reports* of hyperactive/impulsive symptoms was related to having less money (r = -6.94, n = 12, p =.012), going through more cards (r = .602, n = 12, p = .039), and more rounds (r =.602, n = 12, p = .031) on the Card Playing Task. There was a trend in the Predominatly Inattentive Type, of greater DSM-IV inattentive *self-report* symptoms being related to having more money remaining on the task (r = .626, n = 14, p = .071).

In the Combined Type observer reports of hyperactive/impulsive symptoms was related to having faster reaction times to sad faces (r = -.644, n = 12, p = .024). There was no statistically significant relationship between reaction times to sad faces and money remaining

on the Card Playing Task in the full sample of adults with ADHD (r =.307, n = 30, p = .099), but a trend of longer reaction times related to having more money remaining.

A multivariate analysis of variance (MANOVA) testing group difference on the Depression Anxiety Stress Scale (DASS) was significant (Wilks λ = .60, F (3, 54) = 11.99, p < .001, η^2 = .40). The ADHD group had significantly higher levels of reported depression (F (1, 56) = 17.46, p < .001, η^2 = .238), anxiety (F (1, 56) = 17.29, p < .001, η^2 = .236) and stress (F (1, 56) = 36.79, p < .001, η^2 = .396) the week prior to testing (see Table 15).

A MANOVA found group differences on the Global Assessment of Recent Stress (GARS) and this was significant (Wilks λ = .671, F (8, 49) = 2.99, p = .008, η^2 =.329). Subsequent univariate analyses (ANOVA) found the ADHD participants on average reported more recent interpersonal stress (F (1, 56) = 13.33, p = .001, η^2 = .192), changes in relationships (e.g. divorce, death, marriage) (F (1, 56) = 4.69, p = .036, η^2 = .076), pressure caused by financial issues (F (1, 56) = 9.70, p = .003, η^2 = .148), pressure from unusual happenings (e.g. moving, crime) (F (1, 56) = 8.84, p = .004, η^2 = .136) and pressure from change or lack of change in daily routines (F (1, 56) = 13.89, p < .001, η^2 = .199).

A MANOVA of the social support dependent variables was not significant (Wilks λ = .85, F (6, 51) = 1.48, p = .205, η^2 = .149).

Table 15

Psychosocial Functioning by Groups: Means (M) and Standard Deviations (SD) plus F-statistic and Eta-Squared (η^2).

Variable	ADHD (*N* = 30)		Control (*N* = 28)			
	M	*SD*	*M*	*SD*	*F* (1, 56)	η^2
DASS						
Depression	11.87	9.11	3.21	6.30	17.46***	.238
Anxiety	7.90	7.88	1.43	2.50	17.30***	.236
Stress	17.10	9.83	4.53	5.00	36.79***	.397
GARS						
Work/job/school	4.50	3.25	3.32	2.93	2.09	.036
Interpersonal	4.73	2.55	2.32	2.48	13.33***	.192
Changes in relationship	2.73	3.26	1.14	2.26	4.69*	.076
Sickness/injury	2.67	3.25	1.46	2.28	2.62	.045
Financial issues	4.57	3.37	2.25	2.10	9.70**	.148
Unusual happenings	2.30	2.99	.463	1.35	8.84**	.136
Change/lack change	3.63	3.10	1.21	1.52	13.89***	.199
Overall last week	5.07	2.66	2.57	2.50	13.48***	.194
Social Support						
Help distract from worries	2.93	3.56	4.89	5.42	2.68	.046
Help relax when tense	2.43	3.21	5.36	6.16	5.24*	.086
Accepts totally	4.77	12.58	4.32	3.99	.032	.001
Count on regardless	3.07	4.08	4.21	3.81	1.22	.021
Help when ‘down in dumps’	2.67	2.77	5.70	5.57	4.42*	.073
Console when very upset	2.87	3.87	3.54	3.99	.421	.007

Note. DASS = Depression and Anxiety Stress Scales; GARS = Global Assessment of Recent Stress. *$p < .05$, ** $p < .01$, *** $p < .001$

Discussion

Summary of Findings

In this study, we assessed differences in lifetime rates of problems with gambling, reports of problem gambling behaviour, along with forms of gambling played, motivations for gambling, and cognitions experienced while gambling, to document the degree of risk adults with ADHD have in developing problems with gambling in a lifetime as compared with Controls. Of the individuals who had ever gambled on an activity (N = 52), there were significantly more individuals with ADHD categorised as having *some problems with gambling* (46.2%), and greater levels of *probable pathological gamblers* (11.5%) as compared to controls in a lifetime. In addition, there were greater reports of problematic gambling related to ever claiming to be winning, when in fact they were not (less than half the time they lost/most of the time). However, contrary to our hypotheses the rates of probable pathological gambling were generally infrequent in the ADHD group. Yet, it was interesting to note the probable pathological gamblers all at some time met criteria for Post Traumatic Stress Disorder and two of the three had Combined Type of ADHD.

As predicted, motivations for gambling and cognitions experienced during gambling in the ADHD group did significantly differ from the Control group. Specifically, the adults with ADHD reported greater motivations of gambling to relieve tension/help relax, and cognitions of feeling they are unable to stop gambling. In addition, they also differed in the forms of gambling ever played in a lifetime; the ADHD group was more likely to have ever played in the casino, while the control group were more likely to have ever gambled on the lotteries; however, no other significant differences were found.

This study also used a broad range of tests measuring behavioural inhibition, processing speed, emotional processing, and decision-making, set-shifting and planning, to

explore if neuropsychological functioning was poorer in the ADHD group compared to the Controls (in addition to documenting differences within the gambling groups in the ADHD sample). Levels of social support and stress were also compared between the ADHD and Control Groups and in individuals with ADHD across different gambling groups.

Due to the small sample sizes of *probable pathological gamblers* in the ADHD group we could not compare their performance on these measures in the analyses; however, we did compare within the ADHD group those with *some problems with gambling* to those with *no problems with gambling*. Contrary to our hypothesis, this study showed those with some problems with gambling had better neuropsychological performance on the Wisconsin Card Sorting Test (WCST), which measures planning and set-shifting, compared to those with no problems with gambling. Those with probable pathological gambling, also had trends of poorer performance on the WCST compared to those with some problems with gambling. Further analyses revealed those with some problems with gambling had less social support, more opportunity in a lifetime to gamble, and less observer reports of hyperactive/impulsive symptoms compared to those with no problems with gambling. Low social support was also characteristic of the probable pathological gamblers. These findings indicate a balance of risk and protective factors may determine the development of problem/pathological gambling in adults with ADHD.

In comparison to the control group, the ADHD group showed impaired performance on the Continuous Performance Test (CPT) in relation to variability of reaction times, hit reaction times and the confidence index, which does align with ‘top-down’ or ‘cool’ executive function weaknesses as predicted; these functions are thought to be mediated by the Dorsolateral Prefrontal Cortex, and responsible for general cognitive deficits. Slowed reaction times to sad faces on the Emotional Go/No-Go non-set shifting condition in the ADHD group indicated differences in emotional processing (‘hot’ cognition) characterised by

close interconnections with the amygdala. However, contrary to our hypotheses no other differences in measures of executive function were found, suggesting our group of adults with ADHD were not homogenously impaired across domains of 'cool' and 'hot' executive functioning, and therefore, not all neuropsychologically at-risk for addictive behaviour, such as problem gambling.

In line with my hypothesis, the full ADHD sample did have greater levels of recent symptoms related to depression, anxiety and stress. In addition, those with ADHD reported greater recent stress in relation to a range of areas (e.g. interpersonal, changes in relationships, financial issues, unusual happenings, change or lack of change in daily routine). However, the ADHD group overall did not significantly differ on levels of social support.

Problem Gambling and Behaviour in a Lifetime: ADHD vs. Control Groups

Although the ADHD group had higher lifetime rates of *probable pathological gambling* (11.5%), compared to the control group these rates were generally low. However, the presence of two probable pathological gamblers meeting criteria for ADHD Predominantly Combined Type, and demonstrating more severe problem gambling on the South Oaks Gambling Screen, does align with the 'antisocial impulsivist' subtype proposed to be vulnerable to pathological gambling, characterised by high levels of impulsivity and severe problem gambling typically resistant to treatment (Blaszczynski & Nover, 2002). However, due to the small distribution of the probable pathological gamblers it is unclear whether impulsivity was the mediator of the more severe gambling problems or other unexplored factors such as antisocial behaviour was influencing this relationship. Recent research had found young adults with ADHD who met criteria for possible problem gambling also reported having greater trouble with the law, and symptoms of antisocial personality disorder (Breyer et al., 2009). However, other research has found no symptoms of antisocial

personality disorder present in their sample of pathological gamblers (Specker, Carlson, Edmonson, Johnson, & Marcotte, 1996). It may be our sample had lower rates of antisocial behaviour, therefore, contributing to lower rates of pathological gamblers in our study; future research should aim to discern this further.

This was the first known study to explore rates of probable pathological gambling in a sample of adults with ADHD. Previous research examining this relationship, did so in samples of pathological gamblers and found 20% reported childhood behavioural symptoms of ADHD on a questionnaire (Specker, Carlson, Christenson, & Marcotte, 1995). Similar reports have also been found more recently with 29.1% of a sample of pathological gamblers reporting they had experienced higher levels of ADHD symptoms in childhood (Rodriguez-Jimenez et al., 2006). However, in this study the diagnosis of ADHD was confirmed both currently in adulthood and retrospectively in childhood, which required evidence of ADHD symptoms throughout development. This was established thoroughly through a range of modalities, such as interview, self/observer reports and when required reviewing past school reports. Previous research exploring pathological gambling and ADHD had not diagnosed ADHD per se but had explored whether ADHD *symptoms* had been experienced in childhood, which can present in a variety of other psychiatric and medical conditions.

Perhaps other characteristics of individuals with ADHD who have pathological gambling could explain the nature of this relationship. Indeed, Post Traumatic Stress Disorder (PTSD) was found in all three participants with ADHD and pathological gambling. In previous research the diagnosis of Posttraumatic Stress Disorder (PTSD) has been found to occur in 11.9% of adults diagnosed with ADHD (Kessler et al., 2006). Cuffe, McCullough and Pumarlega (1994) suggested although PTSD presents in a similar form to ADHD symptoms, having ADHD may also be a risk factor for traumatic experiences.

Indeed past childhood trauma (abuse/neglect) has been found to be reported by 56% of adults with ADHD (Rucklidge, Brown, Crawford, & Kaplan, 2006) and 32.5% of pathological gamblers (Specker et al., 1996). Other research has found 34% of pathological gamblers had high symptom severity of PTSD which aligned to greater levels of impulsivity and more severe gambling problems (Ledgerwood & Petry, 2006). The presence of PTSD may coincide with the proposed 'emotionally vulnerable' subtype of pathological gamblers (Blaszczynski & Nover, 2002) and align with research revealing a group of pathological gamblers primarily gambling to escape emotional distress (Ledgerwood & Petry, 2006). Therefore, it is possible the influence of PTSD is driving pathological gambling in those with ADHD, however, this requires further exploration in future research.

In this study, the ADHD group also had higher rates of *some problems with gambling* (46.2%) in a lifetime which aligns with other research revealing 19% of young adults with ADHD meeting criteria for *possible problem gambling* (Breyer et al., 2009). The increased rates of some problems with gambling in our sample could be due to examining gambling behaviour within a broader age range (17.3 years – 64.3 years), broader criteria (SOGS = 1-3) and within a lifetime as compared to a 12-month period.

It may be possible that the higher frequency of ADHD participants categorised as having some problems with gambling was due to the greater opportunity playing on 'continuous' forms of gambling compared to controls. Specifically 84.6% ADHD participants (N = 26) were significantly more likely to have ever gambled at the casino as compared with 57.7% of the controls. In contrast, 69.2% of the control participants had ever gambled on the lotteries compared with 42.3% of the ADHD group. Interestingly, 19.2% of the ADHD group had reported they knew a friend or someone important in their lives that ever had a problem with gambling, whereas none of the control group reported this. This may suggest another

avenue for their involvement in gambling activities. Griffth (1999) proposed lotteries were a 'soft' form of gambling, as it does not allow continuous betting within a session. This proposal and these findings are consistent with research showing non-problem gamblers report playing the lotteries more frequently (El-Guebaly et al., 2006) and casino gambling being associated with greater problems with gambling (Welte et al., 2004; Cox, Kwong, Michaud, & Enns, 2000). Indeed, greater problems with gambling in the ADHD group was also evident in self-reports of 15.4% of individuals with ADHD reported feeling they had ever had a problem with gambling, and 23.1% reported ever feeling guilty about the way they have gambled (23.1%), whereas none from the control group reported this.

These self reports of problem gambling may be connected to the higher ratings of cognitions related to feeling they are unable to stop gambling compared to the Control group. Reports of feeling unable to stop gambling had been previously reported by 70% of pathological gamblers (Black & Moyer, 1998), which may indicate similar pathology in the ADHD group. There was also a trend suggesting there were higher ratings of cognitive biases relating to predictive control (e.g. believing they will win again, despite losses) in the ADHD group as compared to the control group. Previous research has found those who endorsed greater cognitions of believing they will continue to win were more likely to continue gambling on a decision-making task and have hypoactivation in areas usually active when deciding to quit (Campbell-Meiklejohn et al., 2008). It may be similar mechanisms were operating in some adults with ADHD in our sample.

Indeed, increases in cognitive biases related to gambling have been found to increase with gambling severity (Oei, 2008). In our study the higher ratings of motivations and cognitions for gambling in the ADHD group may have been due to the presence of probable pathological gamblers in the ADHD group. Specifically, mean ratings on the motivations and cognitions for gambling were generally low, indicating a majority of the ADHD group were

not strongly endorsing these. However, the higher ratings of cognitions related to feeling they are unable to stop gambling in the ADHD group does coincide with the significantly higher lifetime rates of problem gambling behaviour of claiming to be winning when they were not in 19.2% of the ADHD group. In addition, the increased motivations of gambling in order to help relax/relieve tension in the ADHD group aligns with the higher levels of stress, anxiety and depressive symptoms, and trends of having less people to help them relax when under pressure, and when they are generally "down in the dumps" in the full ADHD sample (see Table 15).

Problem Gambling in ADHD: Neuropsychological Functioning, ADHD symptoms and Social Support

This study also sought to explore if poorer neuropsychological functioning differentiated those individuals with ADHD who had some problems with gambling from those with no problems with gambling. Individuals in the ADHD group categorised as having some problems with gambling in a lifetime surprisingly performed better on the Wisconsin Card Sorting test (WCST) which measures planning, set-shifting and abstract thinking, compared to those categorised as having no reported lifetime problems with gambling. Better performance on the Wisconsin Card Sorting Test has been found to reflect improved functioning of the Ventrolateral Prefrontal Cortex (VLPFC) and other areas including the basal ganglia (Nyhus & Barceló, 2009), and is dependent on sound working memory and processing speed (Head, Kennedy, Rodrigue, & Raz, 2009). This may suggest improvement in 'cool' executive functioning is protective against progressing to severe problem gambling. Interestingly, female pathological gamblers have been found to make more perseverative errors and poorer conceptual level responses on the WCST (Álvarez-Moya, Jiménez-Murcia, Moragas, & Gomez-Pena, 2009). A brief exploration of performance on the WCST in the

pathological gamblers in our study also revealed lower scores on this measure compared to those with some problems with gambling.

In addition, researchers have found poor performance on a modified card sorting test in pathological gamblers was also related to poorer decision-making (Brand et al., 2005). We could postulate our results represent similar patterns, with significantly poorer performance on the WCST in those with no problems with gambling, aligning to less money remaining on the Card Playing Task (see Table 8); this pattern was also evident in the pathological gamblers. Indeed, better performance on a decision-making task has also been found to simultaneously activate the Ventral Medial Prefrontal Cortex and Ventral Lateral Prefrontal Cortex in healthy participants, suggesting the interconnections of these brain regions are important for effective decision-making (Berman et al., 1995). It may be those with some problems with gambling have better functioning of the Ventral Lateral Prefrontal Cortex, which may protect them from progressing to ‘chasing losses’ behaviour, and may also reflect greater ability to plan and set-shift, suggesting the influence of better ‘top’ down executive functions.

This poorer neuropsychological performance on the WCST in those with no problems with gambling may be reflecting the distribution of ADHD subtypes and symptoms in this group. To illustrate, those with no problems with gambling had greater levels of Hyperactive/Impulsive Type (18.2%), Combined Type (45.5%) and had less Predominantly Inattentive Type (36.4%) compared to those with some problems with gambling (66.7% Predominately Inattentive Type; 33.3% Combined Type). These differences in the distribution of subtypes of ADHD coincided with significantly more hyperactive/impulsive symptoms as measured by observer report in those with no problems with gambling. It is also interesting to note that two of the three pathological gamblers were categorised as having the Combined Type of ADHD. Therefore, those with some problems with gambling may have

not progressed to pathological gambling due to less hyperactive/impulsive symptoms, which aligned to better functioning of the prefrontal cortices ‘top-down’ executive functioning.

As anticipated, levels of social support differed between the gambling groups in the ADHD sample. Interestingly, those with no problems with gambling had significantly higher levels of social support, relating to having more people to help them feel better when they are generally ‘down in the dumps’, and trends of having more people to distract them from their worries, and help console them when they are very upset. A brief examination of levels of social support on these variables in the pathological gamblers also revealed low social support, with an average one person to count on. These trends may indicate that social support has a role in protecting individuals from seeking gambling activities, and developing gambling problems. Indeed, research has found those with pathological gambling compared to individuals with sub threshold problem gambling endorsed greater levels of loneliness (Namrata & Oei, 2009). Further, females who engage in problematic gambling have also reported higher levels of loneliness, specifically relating to ‘not being understood’ than non-problem female gamblers (Trevorrow & Moore, 1998). It is interesting to note there was a greater frequency of females (63.7%) in the ADHD group with no problems with gambling, compared to 66.7% of males in the ADHD group with some problems with gambling; also, two of the three pathological gamblers were also male. This may suggest social support was protective of females in this study from developing gambling problems, and possibly seeking gambling activities.

Some researchers have proposed social support is a means to buffer stress, and is a coping strategy in itself (Thoits, 1986). In fact, effective coping strategies in the face of stress have been found to be a moderator of youth with and without gambling problems. For example, researchers have found those with higher impulsivity and more severe gambling problems also had more avoidant and distracting coping strategies for dealing with stress

(Nower, Derevensky, & Gupta, 2004). Others have revealed higher impulsivity combined better problem solving in the face of stressors predicted less gambling problems in individuals (Lightsey & Hulsey, 2002). Individuals with ADHD have been found to have a more volatile mood, which has been proposed to be a core feature of the ADHD syndrome (Skirrow et al., 2009). As individuals with ADHD may not have the internal capacity to modulate their mood, they may rely on external coping strategies. Conceivably, it may be those individuals with ADHD who have less people to rely on when they are worried, upset or 'down' seek other external modalities to modulate their mood (e.g. gambling or in some cases substance use) in order to cope.

Other variables also distinguished the gambling groups, those with no problems with gambling who were neuropsychologically at risk, and had greater levels of social support also had significantly less opportunity to gamble in a lifetime on a range of activities (e.g. cards for money, sport, and stock/commodities). This aligns with the dimensional approach to problem gambling where individual vulnerability (risk factors) has to interact with the environment the individual has access to in order to develop problems with gambling (Blaszczynski & McConaghy, 1989).

Those with some problems with gambling also endorsed greater extrinsic motivations related to external regulation (e.g. gambling for rewards/money). Previous research has found gamblers who report motivations of gambling for monetary rewards were less likely to gamble frequently and continue to gamble (Chantal, Vallerand, & Vallieres, 1995). Those with some problems with gambling also had a near significant difference in reporting more gambling expectancies (e.g. gambling will make me happier), which may suggest gambling provides reinforcement for altering their mood. Overall, these findings between the gambling groups in the ADHD sample suggests an array of risk and protective factors may be operating in determining the risk for mild and severe problem gambling in a lifetime.

Neuropsychological and Psychosocial Functioning: ADHD vs. Control Group

Another aim of this study was to investigate neuropsychological functioning using a broad range of tests related to 'top-down' (behavioural inhibition, interference, naming speed, processing speed, planning, set-shifting) and 'bottom-up' executive functioning (decision-making and emotional processing) in the full sample of adults with ADHD, compared to controls. Our findings that the ADHD group (N = 30) had worse neuropsychological functioning on the Continuous Performance Test (confidence index, having a slower and more variable hit reaction time) aligns with our predictions of deficits in the 'top-down'/ 'cool' executive functioning control.

Interestingly the largest effect size (medium to large) was for variability of reaction time (η^2 =.180). This finding is consistent with meta-analytic studies showing variability of reaction time to be a consistent discriminating measure of individuals with and without ADHD, evidencing medium (Marije Boonstra, Oosterlaan, Sergeant, & Buitelaar, 2005) to large effect sizes (Harvey, Esptein & Curry, 2004). The small differences on the confidence index may be explained by the overall weak significant differences on mean hit reaction time and other variables, it is likely the variability of the hit reaction time contributed to the differences on the confidence index, which was at 52.91% in the ADHD sample. It has been suggested deficits in 'cool' executive functions, which are not dependent on emotional signals, would be evident when conducting global analyses of individuals with ADHD (Castellanos, Sonuga-Barke, Milham, & Tannock, 2006). These significant difference in some of the variables in the Continuous Performance Test may be accounted for by the heightened level of inattentive symptoms in this sample of adults with ADHD (see Table 3) which has also previously been associated with 'cool' executive function deficits (Bubier & Drabick, 2008).

The ADHD group also had significantly slower reaction times to sad faces on the non-set shifting component of the Emotional Go/No-Go, suggesting differences in emotional processing ('hot cognition' influenced by bottom-up emotional systems) at a global level between the ADHD and control groups. A slowed reaction time on the sad faces on the non-set shifting component suggests the ADHD participants had consistent slowed reaction times to sad faces across conditions. However, the ADHD and control groups did not significantly differ on reaction times to happy faces. It has been proposed faster reaction times to happy faces reflects healthier functioning, and are also faster as they are generally harder to inhibit (Schulz et al., 2007); as this did not significantly differ between groups, it may indicate similar functioning in this domain.

Previous research has found slowed mean reaction times to fearful expressions was related to increased amygdala activation, and less activation of the Ventral Medial Prefrontal Cortex (VMPFC) (Hare et al., 2008). Our task required the participant to approach sad faces (negative affect) which requires emotional control for optimal performance (faster reaction times). Although we used different emotional stimuli, this may reflect similar processes in the brain regions. However, slower reaction times (increased amygdala activation) to sad faces in the full sample of adults with ADHD was related to obtaining more money on the Card Playing Task (r =.307). This pattern was also evident within the gambling groups in the ADHD sample where slower reaction times to sad faces (469ms) in those with some problems with gambling, was related to having more money remaining ($475); whereas faster reaction times (453ms) in those with some problems with gambling was related to having less money remaining ($181) (see Table 8).

An alternative hypothesis could be increased amygdala activation is related to better performance on the Card Playing Task, as the flood of emotional signals provide information of when to stop gambling. It may also be better performance on the Card Playing Task is

reflecting improved functioning of the Ventral Medial Prefrontal Cortex (VMPFC), so the emotional signals can enter the VMPFC to guide decisions to quit. Alternatively, those with poor performance on the Card Playing Task (decision-making) in our sample may have decreased activation of the amygdala, so emotional signals are unable to assist in guiding decisions of when to stop. This would fit with previous studies documenting decreased sympathetic functioning related to poorer performance on decision-making tasks (Bubier & Drabick, 2008). Interestingly, greater levels of observer reports of hyperactive/impulsive symptoms in the combined type was related to having faster reaction times to sad faces (r = -.644), possibly reflecting less activation of the amygdala.

In addition, when performance on the Card Playing Task (decision-making) was explored within the different ADHD subtypes (Combined Type & Predominantly Inattentive Type) and across ADHD symptoms, there were trends of poorer decision-making in individuals with clinical levels of hyperactivity/impulsivity. Specifically, those with elevations in *observer reports* of impulsivity/hyperactivity in the Combined Type, was related to have less money remaining, gambling through more cards, and progressing through more rounds. However, increases in *self-reported* inattentive symptoms in the Predominantly Inattentive Type were related to having more money remaining. This pattern was also found in the full ADHD sample. These findings of different observer and self reports predicting impairment on the Card Playing Task does align with research showing internalising/inattentive symptoms are often more accurately reported through self-reports and outward manifestations (hyperactivity) more accurately being reported by an informant (Kooij et al., 2008).

These findings are also consistent with other recent proposals of poor decision-making being reflective of those with increased levels of hyperactive/impulsive symptoms (Castellanos et al., 2006) and provides further evidence that individuals with Predominantly

Inattentive Type may not be impaired in 'hot' cognition, which is dependent on the functioning of subcortical 'bottom-up' regions of the brain (Castellani & Rugle, 1995). Globally, our results also suggest neuropsychological functioning is heterogeneous in adults with ADHD, and subtypes may be neuropsychologically distinct, and therefore have different vulnerabilities to addictive behaviour.

Indeed, contrary to the hypotheses, participants in the ADHD group overall did not show any significant differences on the majority of neuropsychological measures presumed to be tapping behavioural inhibition, decision-making, impulsivity and inattention, compared to the control group. No significant differences in the performance between adults with ADHD compared to controls on the computerised version of the WCST has been found in other studies (Nigg, Stavro et al., 2005). Results of meta-analyses have also confirmed our findings, with generally small effect sizes reported across studies, which has proposed to reflect that the task not difficult enough to detect impairments in this area (e.g. Hervey et al., 2004).

The lack of significant differences on the Card Playing Task could be due to the lack of sensitivity of this measure to tap 'affective' decision-making, which is reliant on decisions that are meaningful or important (Zelazo & Müller, 2002). Although participants were guided to be realistic in their decisions to reflect 'real life' decision-making it is likely the hypothetical nature of the game decreased the sensitivity of the task. Previous studies measuring decision-making have used real money to correspond with increases or decreases in hypothetical amounts of money on the Card Playing Task (e.g. Gouchiaan et al., 2008; Goudriaan et al., 2005) or in studies with children have used lollies (e.g. Bubier & Drabick, 2008). This tangible reward or loss may correspond to a more ecologically valid task, tapping the 'affective' component.

Lack of significant differences on the commission and omissions errors on the Emotional Go/No-Go may have been due to the poor sensitivity of this task which has been found to have moderate convergence with the original Go/No-Go Task (*r* =.51-.57) (Schulz et al., 2007); therefore it may be less sensitive to detect subtle differences. However, a similar performance was found between the two groups in rates of omissions and commissions on the Continuous Performance Test (CPT). It has been suggested performance on the CPT may not be clinically meaningful as it generally does not discriminate those with and without ADHD (McGee, Clark, & Symons, 2000). Further, others have found the CPT better classifies Hyperactive/Impulsive Type compared to Predominantly Inattentive Type of ADHD (Edwards et al., 2007). In addition, researchers have revealed increases of omission errors on the CPT being more frequent in the Combined compared to the Predominantly Inattentive Type of ADHD in children (Collings, 2003). Indeed, there were overall greater levels of inattentive symptoms in the ADHD sample, given by the higher levels of Predominantly Inattentive and Combined Type compared to the Hyperactive/Impulsive Type, which may account for our lack of significant findings on these variables. Further, there were also no significant differences on the interference component of the Stroop Task, consistent with previous research (van Mourik, Oosterlaan, & Sergeant, 2005). However, in this study there was a trend of slowed naming of colours in the ADHD group, approaching a medium effect size ($\eta^2 = .054$), which has also been found in other studies (Nigg, 2001).

An alternative hypothesis for our lack of significant effects on the neuropsychological variables in our sample of adults with ADHD could be they were particularly heterogeneous in their executive functioning. This was evident when we explored the differences in neuropsychological performance within the gambling ADHD groups. In fact, it has been suggested neuropsychological deficits are not associated with all cases of ADHD, as it is a heterogeneous disorder with different causal pathways (Sonuga-Barke, 2002). Willcutt,

Doyle, Nigg, Faraone, and Pennington (2005), found in their meta-analytic review of 83 studies of children and adolescents with ADHD that there were moderate effect sizes on neuropsychological measures; however, there was still variance unaccounted for. Marije Boonstra et al. (2005) also noted in their meta-analytic review, that differences in subtype distribution, comorbidity, and the degree they control for the influence of IQ in studies may account for the findings of neuropsychological impairment in adults with ADHD. Other researchers have found one third of adults with ADHD have neuropsychological impairment, but a substantial other proportion do not (Biederman, Petty et al., 2006). If this was the case in our study, it may have been severe executive function impairments were lost at a group level analysis by those ADHD participants with no executive impairment. Nigg, Willcutt, Doyle, and Sonuga-Barke (2005) suggested future research should report the number of individuals with ADHD that evidence significant impairment on executive measures to more accurately reflect the extent of neuropsychological impairment in adults with ADHD.

Small effect sizes on the variables that were not significant suggest limited power may have not been an issue. However, perhaps an elevated full-scale IQ may have compensated for problems in neuropsychological functioning in our study. Indeed, some research has found a relationship between executive functioning and measures of IQ in children (Ardila, Pineda, & Rosselli, 2000). Still, others have still found impairment on executive function tests in adults with ADHD even once full IQ has been controlled for (Nigg, Stavro et al., 2005). In addition, more recently researchers have found weaknesses in processing speed, working memory, and auditory verbal working memory in individuals with ADHD (IQ greater than 120) relative to their overall IQ and compared to the controls (Brown, Reichel & Quinlan, 2009); it may be the neuropsychological measures they used were more sensitive to detect impairment.

It is important to note, the lack of significant differences may have also been due to the level of neuropsychological impairment in the control group. Previous studies had found approximately 16% of the controls had executive function impairments (Biederman, Petty et al., 2006) and executive function impairment could have been more frequent in this sample, for a variety of reasons. Alternatively, perhaps subclinical levels of hyperactivity/impulsivity align with some form of neuropsychological impairment.

The ADHD sample overall had greater levels of recent depression, anxiety and stress symptoms, relative to the control group. The ADHD group also reported greater stressors related to interpersonal and financial issues, problems with daily routines, and overall pressure in the week prior to testing. This is consistent with previous research showing individuals with ADHD experiencing greater everyday stress levels, and emotional over activity to this stress (Wender, Wolf, & Wasserstein, 2006). However, in our sample it is interesting to note the ADHD group were only impaired in the mild range on the Depression and Anxiety Stress Scale (DASS). In addition, the ADHD and Control groups did not significantly differ on many of the social support variables. This may suggest overall, this sample was not severely impaired in psychosocial functioning as a group. It may be some of the individuals from the ADHD group in this study had already sought treatment for their ADHD, as a proportion were recruited from previous studies.

Practical/Clinical Implications

Theoretically these findings suggest not all individuals with ADHD have executive deficits, and that ‘hot’ executive functioning, as previously suggested may be related to Combined Type of ADHD, who may also be more ‘biologically’ vulnerability to severe problem gambling. This initial exploration into the possible mechanisms mediating gambling risk has clinical implications of making practitioners more aware to screen for problem

gambling in adults with ADHD. It also alerts us that the recipe for problem gambling may be dependent on a concoction of different risk and protective factors. Adults with ADHD may be particularly at risk through two pathways; one through the psychosocial consequences of the disorder, which may lead to milder gambling problems and another pathway through the combination of neuropsychological vulnerability and poor psychosocial functioning, which may confer vulnerability to severe levels of problem gambling. This may have implications for possible treatment targets for this heterogeneous group. For example, addressing ways of coping with their ADHD syndrome and associated stress may prevent them from seeking other external ways to cope, such as through gambling. Furthermore, individuals with ADHD who are neuropsychologically at risk may benefit from trialing stimulant medication, to hamper their gambling addiction.

Limitations and Future Research

Despite our findings, several limitations challenge the utility of this study. Firstly, although we extensively recruited ADHD participants and controls, greater numbers would have been desired to detect significant differences. Small sample sizes do also limit the validity of our findings, and did limit the number of analyses we could conduct including regressions of what neuropsychological and psychosocial variables predicted problem gambling. In addition, given the large number of analyses conducted on the sample sizes, it may have increased the rate of Type 1 and Type 2 errors. For example, it is likely there were Type 2 errors in the comparisons of gambling groups within the ADHD sample, which had moderate effect sizes, however were not statistically significant.

Secondly, the measures used to test neuropsychological functioning were likely not sensitive enough, nor were these measures substantially validated. Further, the relationship of emotional processing influencing performance on the decision-making task was not

entirely clear in this study. Future research should aim to simultaneously measure emotional processes within a decision-making paradigm to better gauge this relationship. In addition, future researchers should consider using an incentive in the gambling task to make it more ecologically valid, which has been done in previous research. Future research should also use a broader range of neuropsychological measures, including working memory, and processing speed indexes from the Wechsler Adult Intelligence Scale (WAIS), and the Brown ADD scale which has recently been used in other studies examining neuropsychological performance in adults with ADHD (Brown, Reichel, & Quinlan, 2009). Others have suggested the need for more sensitive measures of executive functioning, which can better reflect impairments in everyday life (Rapport et al., 2001).

In addition, although we did find significant differences in lifetime rates of some problems with gambling and higher rates of probable pathological gambling, there was a relatively small distribution in the ADHD group, and a small number of pathological gamblers. Blaszczynski and Nover (2002) did propose the '*antisocial* impulsivist' is vulnerable to pathological gambling. Rates of lifetime probable pathological gambling have been found in a New Zealand prison population at 21% (McKenna & Giles, 2005). It may be useful for future research to explore pathological gambling in adults ADHD in a prison population, as it may be those with Combined Type of ADHD with severe gambling problems have also sought other high-risk activities leading them into the correctional system. In addition, research exploring gambling behaviour in adults with ADHD should consider using the South Oaks Gambling Screen-revised, which would provide further information of gambling in the previous 6 and 12-months. Also, researchers should explore lifetime rates of internet gambling, given the accessibility of this to all individuals, especially those more socially isolated.

Other variables should also be explored in future research of ADHD and problem gambling, such as coping styles, and the influence of learning disorders. Exploring gender differences and the influence of ADHD subtypes in a larger sample of individuals with ADHD and problems gambling is also required to see if our findings extend to larger samples.

It is worth noting fatigue could have caused some of the control group to have worse performance on the neuropsychological measures, as they firstly were interviewed and then progressed to testing shortly afterwards. Although we did encourage breaks, this may have explained their poorer performance. In contrast, those with ADHD had their interview and testing on separate days. Further, some participants who had been diagnosed with ADHD from previous research studies may have sought various treatment modalities since, and therefore had an improvement in their overall functioning. In addition, despite the 23.3% of ADHD participants not taking their methylphenidate medication on the day of testing, the active ingredient may still have been influencing their performance on the neuropsychological measures. Further, 43.3% of the ADHD participants were taking antidepressant medication at the time of testing which may have had an impact on their testing performance as well as rates of problem gambling.

Fourthly, generality limits the conclusions we can draw from this sample, as the adults with ADHD in this study were high functioning, evident by their high annual income (e.g. 23.3% had an income greater than $70,000) and socioeconomic status (SES) (e.g. Mean = 56.80). In addition, it may also be those individuals with ADHD and severe gambling problems are more impaired, and therefore less likely to volunteer in research.

Also, we did have a portion of individuals with ADHD in our sample with superior IQ which led to a higher average IQ in our sample, compared to previous studies. This may have underestimated the degree of pathological gambling we found in our sample of adults with

ADHD. For example, Antshela et al. (2009) found that their sample of high IQ (>120) adults with ADHD did not differ in rates of substance/alcohol abuse or antisocial personality disorder as compared to the controls, which was in contrast to a majority of other studies finding this relationship. They suggested that high IQ may have protected these individuals with ADHD from progressing to this addictive and antisocial behaviour. It is interesting to note in our ADHD sample, those with some problems with gambling who did not progress to probable pathological gambling in a lifetime, had a higher average IQ (e.g. M = 122.58) compared to the pathological gamblers (M = 101.51). It may be this higher IQ played a role in protecting individuals with ADHD in this sample from progressing to pathological gambling. Therefore, research should replicate these results, to see if rates of problem gambling is more prevalent in a sample representative of the general ADHD population. In addition, a comparison group of pathological gamblers would have been useful in this study to explore ADHD symptoms, and neuropsychological and psychosocial functioning.

Conclusion

In conclusion, the results of this study suggest those with ADHD maybe more prone in a lifetime to seek out gambling activities, and endorse greater levels of problematic behaviour compared, and problem gambling compared to controls. This study has provided researchers in the ADHD field a direction of focus, as we discovered possible risk and protective factors that may have implications for individuals with ADHD who develop some problems with gambling and pathological gambling in a lifetime. Our comparisons of those with some problems with gambling, to no problems with gambling suggest that better neuropsychological functioning in adults with ADHD may protect them from progressing to pathological gambling in the face of less social support and more opportunities in a lifetime to gamble. Further, we confirmed other recent findings that hyperactive/impulsive symptoms

are associated with poorer decision-making, while increases in inattentive symptoms may be protective; this suggests Combined Type and Hyperactive/Impulsive Type of ADHD may be neuropsychologically at risk for gambling problems. Global analyses of executive functioning indicated individuals with ADHD are heterogeneous in terms of executive functioning, and were possibly less impaired compared to previous samples.

Future research is needed to explore the relationship of pathological/problem gambling and ADHD in a prison population, and to tease apart in a larger sample the predictors of problem gambling in adults with ADHD. Until future studies explore the relationship of ADHD and problem gambling in a larger sample, we cannot be confident of the precise mechanisms underlying problem gambling in adults with ADHD.

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Appendix A

History Questionnaire

Your name: _____
Date of birth: _____
Today's date: _____

The purpose of this questionnaire is to obtain some background information about you. The information you provide is confidential and will only be used for research purposes.

1. Please indicate which of the following ethnic groups you belong to (you may tick more than one).

NZ European / Pakeha ☐
NZ Maori ☐
Samoan ☐
Tongan ☐
Niuean ☐
Chinese ☐
Indian ☐
European ☐
Other ☐ (please specify) _____

2. Please indicate which of the following describes your current marital status:

Married ☐
De facto relationship ☐
Single ☐
Divorced ☐
Widow ☐
Other (please specify) _____ ☐

3. Please indicate all of the following statements that describe your home situation:

I have dependent children who are living with me ☐
I have children but they do not live with me ☐
I live with others who aren't related to me (flatmates/ boarders) ☐
I live in my parents' home, supported by my parents ☐
I live alone ☐
I support my dependent parents or relatives who are living with me ☐
Other (please specify) _____ ☐

4. What is your occupation? _____

5. What is your partner's occupation (if applicable)? _____

6. Please indicate your highest educational qualification using the list below:

No school qualifications ☐
5th Form School certificate in one or more subjects (or level 1 NCEA) ☐
Sixth form certificate in one or more subjects (or NCEA level 2) ☐
University entrance in one or more subjects (or NCEA level 3) ☐
Post- secondary (e.g. diploma, trade certificate) ☐
NZ Undergraduate University degree ☐
NZ Postgraduate University degree ☐
Overseas University qualification ☐ (please specify)

Other qualification ☐ (please specify)

7. Please indicate which of the following best describes your total yearly household income before tax (include income from all sources):

Less than $20,000 ☐
$20,000 to $30,000 ☐
$30,000 to $40,000 ☐
$40,000 to $50,000 ☐
$50,000 to $60,000 ☐
$60,000 to $70,000 ☐
More than $70,000 ☐

8. Have you ever been in contact with any social agency, psychologist, psychiatrist, or private agency? YES ☐ NO ☐

If **YES**, please list:

Year	Name of professional	Reason for visit

9. Are you currently being prescribed any medications?

YES ☐ NO ☐

If **YES**, what are the medications being prescribed (please list):

_____
_____
_____
_____
_____

10. Have you ever had a head injury with loss of consciousness?

YES ☐ NO ☐

11. Did teachers ever approach your parents about problems with your behaviour?

YES ☐ NO ☐

12. Were you ever excluded from school? (suspended or expelled)

YES ☐ NO ☐

Please write below any other important information about yourself that you think we should be aware of.

_____
_____
_____
_____
_____
_____

Thank you for completing the questionnaire

Appendix B

B1: South Oaks Gambling Screen

Name: **Date:**

1. Please indicate which of the following types of gambling you have done in your lifetime. For each type, mark one answer: **"Not at All", "Less than Once a Week",** or **"Once a Week or More".**

PLEASE "TICK" ONE ANSWER FOR EACH STATEMENT :	NOT AT ALL	LESS THAN ONCE A WEEK	ONCE A WEEK OR MORE
a. Played cards for money			
b. Bet on horses, dogs, or other animals (at TAB, the track or with a bookie)			
c. Bet on sport			
d. Played dice games, including craps, over and under or other dice games.			
e. Went to casino (legal or otherwise)			
f. played the numbers of bet on lotteries			
g. Played bingo			
h. Played the stock and/or commodities			
i. Played slot machines, poker machines, or other gambling machines			
j. Bowled, shot pool, played golf, or some other game of skill for money.			
k. Played pull tabs or "paper" games other than lotteries.			
l. Some form of gambling not listed above (please specify:…….			

2. What is the largest amount of money you have ever gambled with on any one-day?

---------Never gambled

---------$1 or less

---------More than $1 up to $10

---------More than $10 up to $100

----------More than $100 up to $1,000

----------More than $1,000 up to $10,000

---------- More than $10,000

3. Check which of the following people in your life has (or had) a gambling problem.

_____ Father _____ Mother

_____ Brother/Sister _____ My Spouse/Partner

_____ My Child(ren) _____ Another Relative

_____ A Friend or Someone Important in My Life

4. When you gamble, how often do you go back another day to win back money you have lost?

_____ Never _____ Most of the Times I Lose

_____ Some of the Time (less than half the time I lose) _____ Every Time I Lose

5. Have you ever claimed to be winning money gambling, but weren't really? In fact, you lost?

_____ Never _____ Yes, less than half the time I lost _____ Yes, most of the time

6. Do you feel you have ever had a problem with betting or money gambling?

_____ No _____ Yes _____ Yes, in the past, but not now

7. Did you ever gamble more than you intended to? _____ Yes _____ No

8. Have people criticized your betting or told you that you had a problem, regardless of whether or not you thought it was true? _____ Yes _____ No

9. Have you ever felt guilty about the way you gamble, or what happens when you gamble?

_____Yes _____ No

10. Have you ever felt like you would like to stop betting money on gambling, but didn't think you could? _____ Yes _____ No

11. Have you ever hidden betting slips, lottery tickets, gambling money, IOUs, or other signs of betting or gambling from your spouse, children or other important people in your life?

_____ Yes _____No

12. Have you ever argued with people you live with over how you handle money?

_____ Yes _____No

(If you answered "Yes" to question 12) Have money arguments ever centred on your gambling?
_____ Yes _____ No

14. Have you ever borrowed from someone and not paid them back as a result of your gambling?
_____ Yes _____ No

15. Have you ever lost time from work (or school) due to betting money or gambling?
_____ Yes _____ No

16. If you borrowed money to gamble or to pay gambling debts, who or where did you borrow from (check "Yes" or "No" for each):

a. From household money _____ Yes _____ No
b. From your spouse _____ Yes _____ No
c. From other relatives or in-laws _____ Yes _____ No
d. From banks, loan companies, or credit unions _____ Yes _____ No
e. From credit cards _____ Yes _____ No
f. From loan sharks _____ Yes _____ No
g. You cashed in stocks, bonds or other securities _____ Yes _____ No
h. You sold personal or family property _____ Yes _____ No
i. You borrowed on your checking accounts (passed bad checks) _____ Yes _____ No
j. You have (had) a credit line with a bookie _____ Yes _____ No
k. You have (had) a credit line with a casino _____ Yes _____ No

_____

SOUTH OAKS GAMBLING SCREEN – SCORE SHEET
[SOGS]

Scores on the SOGS are determined by scoring one point for each question that shows the "at risk" response indicated and adding the total points.

Question 1 ___X_ Not counted
Question 2 ___X_ Not counted
Question 3 ___X__Not counted
Question 4 _____ Most of the time I lose or Yes, Every time I Lose
Question 5 _____ Yes, less than half the time I lose or Yes, most of the time
Question 6 _____ Yes, in the past but not now or Yes
Question 7 _____ Yes
Question 8 _____ Yes
Question 9 _____ Yes
Question 10 _____ Yes
Question 11 _____ Yes
Question 12 ___X__Not counted
Question 13 _____ Yes
Question 14 _____ Yes
Question 15 _____ Yes
Question 16 a _____Yes
Question 16 b _____Yes
Question 16 c _____Yes
Question 16 d _____Yes
Question 16 e _____Yes
Question 16 f _____Yes
Question 16 g _____Yes
Question 16 h _____Yes
Question 16 i _____Yes
Question 16 j X Not counted
Question 16 k X Not counted

TOTAL POINTS:

(Maximum score = 20)

INTERPRETING THE SCORE:

0 = No problem with gambling

1-4 = Some problems with gambling

5 or more Probable pathological gambler

B2: The Gambling Related Cognition Scale (GRCS)

Please indicate (by circular) the extent to which you agree with the value expressed in each statement. **1= strongly disagree**; **2= moderately disagree**; **3= mildly disagree**; **4= neither agree nor disagree; 5= mildly agree; 6= moderately agree; 7= strongly agree**.

1.	Gambling makes me happier	1	2	3	4	5	6	7
2.	I can't function without gambling	1	2	3	4	5	6	7
3.	Praying helps me win	1	2	3	4	5	6	7
4.	Losses when gambling are bound to be followed by a series of wins	1	2	3	4	5	6	7
5.	Relating my winnings to my skill and ability Makes me continue gambling.	1	2	3	4	5	6	7
6.	Gambling makes things seem better	1	2	3	4	5	6	7
7.	It is difficult to stop gambling as I am so Out of control	1	2	3	4	5	6	7
8.	Specific number and colours can help increase my chances of winning.	1	2	3	4	5	6	7
9.	A series of losses will provide me with a learning experience that will help me win later.	1	2	3	4	5	6	7
10.	Relating my losses to bad luck and bad Circumstances make me continue gambling.	1	2	3	4	5	6	7
11.	Gambling makes the future brighter	1	2	3	4	5	6	7
12.	My desire to gambling is so overpowering	1	2	3	4	5	6	7
13.	I collect specific objects that help increase my chances of winning.	1	2	3	4	5	6	7
14.	When I have a win once, I will definitely win Again.	1	2	3	4	5	6	7
15.	Relating my losses to probability makes me continue gambling.	1	2	3	4	5	6	7
16.	Having a gamble helps reduce tension and and stress	1	2	3	4	5	6	7
17.	I'm not strong enough to stop gambling	1	2	3	4	5	6	7
18.	I have specific rituals and behaviours that increase my chances of winning	1	2	3	4	5	6	7
19.	There are times that I feel lucky and thus, gamble those times only.	1	2	3	4	5	6	7
20.	Remembering how much money I won last time makes me continue gambling.	1	2	3	4	5	6	7
21.	I will never be able to stop gambling	1	2	3	4	5	6	7
22.	I have some control over predicting my gambling wins.	1	2	3	4	5	6	7
23.	If I keep changing numbers, I have less chances of winning than if I keep the same numbers every time.	1	2	3	4	5	6	7

SCORING FOR GRCS:

Perceived Inability to Stop: 2, 7, 12, 17, 21

Gambling Expectancies: 1, 6, 11,16.

Interpretive Bias: 5, 10, 15, 20

Illusion of Control: 3, 8, 13, 18.

B3: Gambling Motivations Scale

For each of the following items, please circle the number that best represents the extent to which the item corresponds to the reasons why you play your favourite gambling game. For example, if the item doesn't correspond at all, circle number 1; if it corresponds moderately, circle number 4; if it corresponds exactly, circle number 7.

Does not correspond at all	Corresponds a little	Corresponds moderately	Corresponds a lot	Corresponds exactly
1	2	3	4	5	6	7

WHY DO YOU PLAY FOR MONEY (BET) AT YOUR FAVORITE GAME?

1.	Because it is exciting to play for money.	1	2	3	4	5	6	7
2.	Because it makes me feel like somebody important.	1	2	3	4	5	6	7
3.	For the feeling of efficacy that I get when I play my favourite game.	1	2	3	4	5	6	7
4.	Because, for me, it is the best way to relax completely.	1	2	3	4	5	6	7
5.	I play for money, but sometimes I ask myself if I should continue to play my favourite game.	1	2	3	4	5	6	7
6.	Because playing for money allows me to test my capacity to control myself.	1	2	3	4	5	6	7
7.	I play for money, but sometimes I ask myself what I get out of it.	1	2	3	4	5	6	7
8.	To get rich.	1	2	3	4	5	6	7
9.	To show others that I am a dynamic person.	1	2	3	4	5	6	7
10.	For the pleasure I get at improving my knowledge of the game.	1	2	3	4	5	6	7
11.	To buy something that I dream of.	1	2	3	4	5	6	7
12.	Because it allows me to enjoy myself enormously.	1	2	3	4	5	6	7
13.	Because it is the best way I know of to eliminate tension.	1	2	3	4	5	6	7
14.	For the strong sensations I feel when I play my favourite game.	1	2	3	4	5	6	7
15.	For the satisfaction of learning new ways of playing my favourite game.	1	2	3	4	5	6	7
16.	To be envied by others.	1	2	3	4	5	6	7
17.	Because it is the hobby I have chosen to clear my mind.	1	2	3	4	5	6	7
18.	For the pleasure of knowing my abilities at this game.	1	2	3	4	5	6	7
19.	For the satisfaction I feel when I can control the game.	1	2	3	4	5	6	7
20.	For the curiosity of knowing what can happen in the game.	1	2	3	4	5	6	7
21.	I play for money but sometimes I feel I am not getting a lot out of it.	1	2	3	4	5	6	7

22. To make money quickly and easily.	1	2	3	4	5	6	7
23. Because it's the best way I know of to meet my friends.	1	2	3	4	5	6	7
24. For the feeling of control it gives me.	1	2	3	4	5	6	7
25. I play for money but I sometimes ask myself if it is good for me.	1	2	3	4	5	6	7
26. Because when I win, I feel like someone important.	1	2	3	4	5	6	7
27. To make a lot of money.	1	2	3	4	5	6	7
28. For the thrill or the strong sensations it gives me.	1	2	3	4	5	6	7

SCORING:

Intrinsic Motivations:

Stimulation/Excitement: 1, 12, 14, 28.

Knowledge: 10, 15, 18, 20.

Accomplishment: 3, 6, 19, 24.

Extrinsic Motivations:

External Regulation: 8, 11, 22, 27.

Introjected Regulation: 2, 9, 16, 26.

Identified Regulation: 4, 13, 17, 23.

Amotivation: 5, 7, 21, 25.

B4: Information Sheet: Card Playing Task

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

This is a simulation of a real gambling game with cards which are not from one set. Red cards (i.e., Hearts and Diamonds) represent hypothetical monetary gains and black cards (i.e., Spades and Clubs) represent hypothetical monetary losses; every win or loss is $50. The goal for you is to win as much money as

possible. You are given $500 initially as your stake. The balance after every win or loss can be viewed on the screen. Although the wins and the losses are hypothetical, please imagine them as realistically as you can. There is no time limit for playing the game. Feel free to click the "QUIT" button to terminate the game at anytime you want to stop playing. You are supposed to make a mouse-click on the first card to begin the game when you are ready, then every time click the top card to see the next one. Good luck and have fun!

Appendix C

C1: Global Assessment of Stress

Instructions: The following is an attempt to evaluate the amount of stress you have been under *during the past week.* Several areas where stress could occur are listed below. Think of stress as a feeling of "pressure". Consider each area, if no pressure existed, circle the mark under the word *none. None* would mean that you felt comfortable, free from worry or distress, without major problems or events that upset your usual routine. *Extreme* would mean that you felt very upset, perhaps even noticed physical reactions, such as tension, upset stomach, headache, etc., or that you were mentally distressed, anxious, grieving. Not all stress or pressure comes from bad events that happen, some happy events also cause a lot of pressure. Consider these too. For each of the following, circle the mark on the line that indicates how much "pressure" you have been under *in the past week.*

Pressure Related To Work/Job/School. (Whether self-imposed or not)

None Extreme

Pressure In Interpersonal Relationships. (Family members and/or significant persons).

None Extreme

Pressure Caused by Changes In Your Relationships. (Death, birth, marriage, divorce, etc.)

None Extreme

Pressure Caused by Sickness or injury. (Self, others, or both).

None Extreme

Pressure Caused by Financial Issues

None Extreme

Pressure From Unusual Happenings. (Crime, natural disaster, accident, moving, etc.)

None Extreme

Pressure From Change or Lack of Change in Daily Routine.

None Extreme

Estimate of Overall Level of Pressure During the Past Week.

None Extreme

Appendix C2: Depression and Anxiety Stress Scale (DASS)

DASS

Name: *Date:*

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you *over the past week*. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

0 Did not apply to me at all
1 Applied to me to some degree, or some of the time
2 Applied to me to a considerable degree, or a good part of time
3 Applied to me very much, or most of the time

1	I found myself getting upset by quite trivial things	0	1	2	3

2	I was aware of dryness of my mouth	0	1	2	3
3	I couldn't seem to experience any positive feeling at all	0	1	2	3
4	I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	0	1	2	3
5	I just couldn't seem to get going	0	1	2	3
6	I tended to over-react to situations	0	1	2	3
7	I had a feeling of shakiness (eg, legs going to give way)	0	1	2	3
8	I found it difficult to relax	0	1	2	3
9	I found myself in situations that made me so anxious I was most relieved when they ended	0	1	2	3
10	I felt that I had nothing to look forward to	0	1	2	3
11	I found myself getting upset rather easily	0	1	2	3
12	I felt that I was using a lot of nervous energy	0	1	2	3
13	I felt sad and depressed	0	1	2	3
14	I found myself getting impatient when I was delayed in any way (eg, lifts, traffic lights, being kept waiting)	0	1	2	3
15	I had a feeling of faintness	0	1	2	3
16	I felt that I had lost interest in just about everything	0	1	2	3
17	I felt I wasn't worth much as a person	0	1	2	3
18	I felt that I was rather touchy	0	1	2	3
19	I perspired noticeably (eg, hands sweaty) in the absence of high temperatures or physical exertion	0	1	2	3
20	I felt scared without any good reason	0	1	2	3
21	I felt that life wasn't worthwhile	0	1	2	3

Reminder of rating scale:

0 Did not apply to me at all
1 Applied to me to some degree, or some of the time
2 Applied to me to a considerable degree, or a good part of time
3 Applied to me very much, or most of the time

22	I found it hard to wind down	0	1	2	3
23	I had difficulty in swallowing	0	1	2	3
24	I couldn't seem to get any enjoyment out of the things I did	0	1	2	3
25	I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)	0	1	2	3
26	I felt down-hearted and blue	0	1	2	3

27	I found that I was very irritable	0	1	2	3
28	I felt I was close to panic	0	1	2	3
29	I found it hard to calm down after something upset me	0	1	2	3
30	I feared that I would be "thrown" by some trivial but unfamiliar task	0	1	2	3
31	I was unable to become enthusiastic about anything	0	1	2	3
32	I found it difficult to tolerate interruptions to what I was doing	0	1	2	3
33	I was in a state of nervous tension	0	1	2	3
34	I felt I was pretty worthless	0	1	2	3
35	I was intolerant of anything that kept me from getting on with what I was doing	0	1	2	3
36	I felt terrified	0	1	2	3
37	I could see nothing in the future to be hopeful about	0	1	2	3
38	I felt that life was meaningless	0	1	2	3
39	I found myself getting agitated	0	1	2	3
40	I was worried about situations in which I might panic and make a fool of myself	0	1	2	3
41	I experienced trembling (eg, in the hands)	0	1	2	3
42	I found it difficult to work up the initiative to do things	0	1	2	3

C3: Social Support Questionnaire – Short Form

1. Whom can you really count on to distract you from your worries when you feel under stress?

2. Whom can you really count on to help you feel more relaxed when you are under pressure or tense?

3. Who accepts you totally, including both your worst and your best points?

4. Who can you really count on to care about you, regardless of what is happening to you?

5. Who can you really count on to help you feel better when you are feeling generally down-in-the-dumps?

6. Who can you count on to console you when you are very upset?