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Impulsivity, negative affectivity, and personality psychopathology: Their relation to the development of problem gambling.

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IMPULSIVITY, NEGATIVE AFFECTIVITY, AND PERSONALITY PSYCHOPATHOLOGY: THEIR RELATION TO THE DEVELOPMENT OF PROBLEM GAMBLING

by
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ABSTRACT

Much of the recent literature in the area of problem gambling has focused on impulsivity and negative affectivity as major independent dimensions that contribute to the development of pathological gambling. Personality disorders have also been identified as common comorbid factors in samples of problem and pathological gamblers. However, few studies in the area of personality psychopathology and gambling have gone beyond simply citing comorbidity statistics. Many of the personality disorders that have been identified in samples of pathological gamblers have impulsivity and negative affectivity as key characteristics. Using both a referred sample (n=97) and a student sample of gamblers (n=486), the present study proposed to test whether personality disorders account for additional variance in the extent of problem gambling above and beyond impulsivity and negative affectivity. Gender was also tested as a possible moderator in this relationship. Two personality disorder measures were included that identify dimensional scores for all 10 personality disorders. Additionally, measures of impulsivity, sensation seeking, positive affectivity, negative affectivity, and reward and punishment sensitivity were included as the temperament variables in the study. The variables were reduced using Principal Components Analysis and the component scores were used as the predictor variables in the regression analyses. Results indicated that the narcissistic and impulsive personality disorder components fully account for the relationship between the impulsive and the negative affectivity temperament variables with problem gambling severity in the student sample. Thus, the personality disorder dimensions accounted for unique incremental variance above and beyond that accounted for by the temperament variables. In the referred sample, the asocial personality disorder

component was the only meaningful predictor of problem gambling severity based on the results of a backward entry regression analysis. Gender was identified as a predictor of problem gambling severity in the student sample and as a mediator of both impulsivity's and positive affectivity's relations with problem gambling severity in the referred sample. The inclusion of gender as a covariate did not alter the significance of the personality disorder effects.

DEDICATION

I would like to dedicate this project to my partner Sean,

I am not sure I could have gotten this far without you.

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INTRODUCTION

Overview of the present study

Currently, pathological gambling is viewed most widely as an impulse disorder. It was first classified as a distinct psychiatric disorder with the publication of DSM-III (APA, 1980) in which it was identified as an Impulse Control Disorder Not Elsewhere Specified and remains so in the current version (DSM-IV-TR; APA, 2000). Impulse Control Disorders are described as problems for which the essential feature is "the failure to resist an impulse, drive, or temptation to perform an act that is harmful to the person or others" (p. 663; APA, 2000).

While a strong emphasis on the impulsive component of this disorder continues, the DSM-IV-TR (APA, 2000) criteria that delineate pathological gambling have several characteristics in common with other types of disorders. There is criteria overlap with substance dependence: *needs to gamble with increasing amounts of money in order to achieve the desired excitement; has repeated unsuccessful efforts to control, cut back or stop gambling; is restless or irritable when attempting to cut down or stop gambling.* Other criteria are suggestive of antisocial personality disorder: *lies to family members, therapist, or others to conceal the extent of involvement with gambling; has committed illegal acts such as forgery, fraud, theft, or embezzlement to finance gambling.* Lastly, one of the criteria for this disorder also implies a link to affective disorders: *gambles as a way of escaping from problems or of relieving a dysphoric mood (e.g., feelings of helplessness, guilt, anxiety, depression).* This obvious overlap with other disorders indicates that impulsivity is not the only core feature of pathological gambling and suggests that other underlying factors may promote or exacerbate its development.

The purpose of this study is to provide greater insight into the role of personality psychopathology in the exacerbation of gambling problems. Currently two characteristics are considered to be the forerunners as possible etiological factors in problem gambling. These are impulsivity and negative affectivity. In more recent typological models of this disorder, both of these traits are considered to be key pathways in its development (e.g., Blaszczynski & Nower, 2002). These are also core characteristics of many of the personality disorders currently delineated in the DSM-IV-TR (APA, 2000).

To date, personality psychopathology has only been superficially explored as a possible mechanism of problem gambling severity. Recent studies have identified high rates of personality disorders in samples of problem gamblers (e.g., Blaszczynski & Steel, 1998; Ibanez, Blanco, Donahue, Lesieur, Perez de Castro, et al., 2001; Fernández-Montalvo & Echeburúa, 2004). In particular, these studies have found higher rates of antisocial, avoidant, and obsessive-compulsive personality disorders among problem gamblers (Black & Moyer, 1998). In spite of these findings, most works have focussed solely on antisocial personality disorder for which impulsivity is a key diagnostic component (e.g., Blaszczynski & Steel, 1998). It is possible that impulsivity may be what mediates the link between this specific disorder and pathological gambling. Other antisocial traits apart from impulsivity have also been linked to pathological gambling (see DSM-IV-TR criteria listed above). Yet, the temporal relationship between the onset of these behaviours and development of pathological gambling has not yet been determined (Blaszczynski, McConaghy, & Frankova, 1989). It is unclear whether these traits exist prior to the onset of the gambling problems or as a result.

With regards to most personality disorders negative affectivity and/or impulsivity are core aspects of these disorders. It remains unclear at this stage which aspects of personality psychopathology may play a role in the development or exacerbation of problem gambling. It may be that the temperament variables of negative affectivity and impulsivity fully account for the relationship between most personality disorders and problem gambling. Otherwise, personality disorders may provide additional explanatory power for better understanding either the development or exacerbation of problem gambling.

Attempts thus far to develop a comprehensive model of problem gambling have focused solely on the separate influence of these factors leading to typological models of problem gambling (Moran, 1970; Blaszczynski, McConaghy, & Frankova, 1989; Blaszczynski, 2002; Blaszczynski & Nower, 2002). For the most part, these typological models have attempted to categorize gamblers based on their predominant comorbid symptoms and claim that problem gamblers form a heterogeneous group.

Given the evident importance of impulsivity and negative affectivity, it is important to establish whether the temperament variables can account for the high personality disorder comorbidity rates within samples of problem gamblers or, if there is additional information to be gleaned from these personality disorder findings. This study will seek to establish how they each, individually and combined, influence pathological gambling. To date, no study has been found that has investigated the relation between these core constructs as predictors of pathological gambling. To do so would represent an important contribution to the literature with, potentially, major implications for the treatment of problem gambling.

Problem gambling in North America

Pathological gambling leads to significant psychological, social, legal, and financial problems and is a problem increasing in scope (Volberg, 2002). A Harvard research study cited the prevalence rates in the U.S. from 1977 to 1993 at 4.4% of the adult population and from 1994 to 1997 at 6.7% (Volberg, 2002). This dramatic increase in prevalence rate has been linked to the increased availability of legalized gambling opportunities (Ladouceur, 1996; Raylu & Oei, 2002). In a meta-analysis of 120 studies, the prevalence rates for problem gambling was noted at 1.6% for adults, 3.9% among youth, 4.7% among college students and 14.2% among substance abusers (Shaffer, Hall & Vander Bilt, 1999). In Canada the overall rate is estimated at 2% (Ladouceur, 1996; Shaffer, Hall, & Vander Bilt, 1999). Further examination of gambling in Canada is needed since most of the available research has stemmed from either the United States or Australia (Wynne, 2002). Relatedly, examination of subpopulations among problem gamblers would appear to be of increasing importance. Emerging phenomena such as online gambling (particularly online poker among college students) may be having differential impact on gambling populations as a function of population characteristics. Research in this area, however, is currently in its infancy.

Problem gambling versus pathological gambling

Considerable variability exists in how individuals with gambling problems are described in the literature. Prior to the inclusion of pathological gambling in DSM-III (APA, 1980), the term *compulsive gambler* was most often used. *Compulsive gambler* is still common in lay descriptions of problem gambling as well as in terminology employed by the Gamblers Anonymous organization (Raylu & Oei, 2002). Clinicians and

researchers, however, avoid the term compulsive since it can be argued that this disorder is more impulsive than compulsive as compulsivity implies ego-dystonic behaviour (APA, 2000). The term *pathological* is used most often when a clear-cut diagnosis based on DSM criteria can be determined (APA, 1980; 1987; 1994; 2000). The term *problem gambler* is used in the recent literature in two different contexts. In the first context, it is utilized to describe sub-threshold pathological gamblers (Lesieur & Blume, 1987). For example, individuals who do not meet sufficient DSM criteria yet do suffer negative consequences due to their gambling behaviour are called *problem gamblers*. Furthermore, certain gambling inventories group respondents according to problem severity such as social gambler, problem gambler, and pathological gambler (e.g., the SOGS; Lesieur & Blume, 1987). A second application of the term *problem gambler* is as an all-encompassing term that includes both problem and pathological gamblers. For example, Wynne's operational definition of problem gambling is, "gambling behaviour that creates negative consequences for the gambler, others in his or her social network, or for the community" (p. 18; Wynne, 2003). Since most gambling studies vary in the criteria used to identify the problem and pathological gamblers in their samples, the term *problem gambler* will be used for the remainder of this paper.

Typological models of problem gambling

Over the years, aspects of impulsivity, negative affectivity and features of psychopathy (i.e., antisocial personality disorder) have been proposed as etiological factors for subtypes of problems gamblers. Various models of have been proposed utilizing most or all of these traits. The first typological model was based on observation. Moran (1970) observed different types of gamblers during intake interviews. He

identified 5 subgroups: the subcultural variety (in which gambling problems were considered to be learned or part of a subculture), the neurotic variety (anxious gamblers searching for relief or distraction from a stressful situation), the impulsive variety (in which gamblers displayed a loss of control and ambivalence towards gambling), the psychopathic variety, and the symptomatic variety (a group of gamblers who suffered from a mental illness, most often from depression). Moran (1970), however, did not consider these to be mutually exclusive categories.

Zimmerman, Meeland, and Krug (1985) performed a factor analysis on multiple personality variables related to problem gambling. They came up with eight factors, of which only five discriminated gamblers from non-gamblers. Of these five, the first factor pertained to neurotic gambling and reflected an underlying anxiety and maladjustment. High scorers on this factor perceived gambling as a release from worry and frustration. Moreover, these individuals felt inadequate and indicated that gambling was more important than other social activities. They also reported more somatic symptoms (e.g. difficulty sleeping). The second factor related to psychopathic gambling. Individuals who scored high on this factor had antisocial features, were not generous, and became bored in social situations. Individuals scoring high on the third factor were the impulsive risk-takers with high energy levels and an increased desire to initiate projects. The fourth factor in this study related to the commission of white-collar crime. The seventh factor related to employment problems (Zimmerman, Meeland & Krug, 1985).

Steel and Blaszczynski (1996) also attempted to identify the major underlying constructs of problem gambling by utilizing measures of antisocial personality disorder, impulsivity and sensation seeking. They found four underlying factors. These included

psychological distress, sensation seeking, crime and liveliness, and impulsive-antisocial traits that were found to be independent predictors of pathological gambling behaviour (Steel & Blaszczynski, 1996). The authors described the last factor, impulsive-antisocial traits, as being the most clinically useful as it was associated with variables such as early onset gambling, a high number of jobs with short periods of employment, divorce, and illegal activities. This factor was highly correlated with the psychological distress factor. They opted to combine impulsivity with antisocial personality as they found high correlations among these variables and proposed that they should be combined into the same construct as they found differentiating between the two constructs "difficult" (p. 85; Blaszczynski, Steel, & McConaghy, 1997).

In a later paper, Blaszczynski and Nower (2002) argued that pathological gambling has yet to be adequately defined and is likely comprised of a heterogeneous population with respect to etiology. In an effort to integrate biological, developmental, and ecological factors they proposed a model of pathological gambling identifying three distinct groups of gamblers: behaviourally conditioned gamblers, emotionally vulnerable gamblers, and antisocial-impulsivist gamblers. This model has not yet been tested empirically.

Given the evidence that many of the factors identified as "problem gambler typologies" are correlated and are not likely exclusionary, it is probable that there is interplay between the emotional vulnerability, impulsivity, and other dysfunctional characterological traits that have been identified in past studies.

The role of impulsivity in problem gambling

Impulsivity has been identified as a key descriptor in most problem gambling studies, including the typological studies described above. Since Pathological Gambling was included in the Impulse Control Disorder Not Elsewhere Specified section of the DSM (DSM-III; APA, 1980), the focus on the role of impulsivity in the development and exacerbation of this disorder has increased. Impulse control disorders are problems that are characterized by an uncontrollable impulse to perform harmful acts (APA, 2000). According to DSM-IV-TR, most impulsive individuals tend to experience an increasing sense of tension or arousal before committing the act and experience pleasure, gratification or relief following completion of the act (APA, 2000). Pathological gamblers have been shown to have high levels of trait impulsivity (Moran, 1970; Steel & Blaszczynski, 1996; Gonzalez-Ibanez, Jimenez et al. 1999); and impulsivity has also been reported to be a good index of the severity of the gambling problem (McCormick et al., 1987; Steel & Blaszczynski, 1996; Gonzalez-Ibanez, Jiminez, & Aymami, 1999; Petry, 2001; Zimmerman, Meeland & Krug, 1985; Alessi & Petry, 2003). Furthermore, many studies have found that highly impulsive gamblers tend to experience greater disruptions in their social, interpersonal, and occupational functioning (McCormick, 1993; Blaszczynski & Nower, 2002). This finding has also held true in a prospective study with adolescent males that found impulsivity was a good predictor of gambling behaviour (Vitaro, Arseneault, & Tremblay, 1999). Several impulse control disorders have been found to have high comorbidity rates with pathological gambling (Specker, Carlson, Christenson, & Marcotte, 1995). These include attention-deficit hyperactivity disorder (ADHD) (Carlton, Manowitz, McBride, Nora, et al., 1987; Rugle & Melamed, 1993),

antisocial personality disorder (Lesieur, 1987; Blaszczynski, McConaghy & Frankova, 1989), and substance abuse disorders (Ladouceur, Dube & Bujold, 1994; Lesieur, Cross, Frank, White, et al., 1991). Suicidal behaviour has likewise been found to have a high comorbidity with pathological gambling (Ladouceur, et al., 1994; Lesieur, et al., 1991).

With respect to gender, impulsivity has been proposed to play a greater role in the development of problem gambling in males than in females (Ibanez, Blanco, Moreryra, & Saiz-Ruiz, 2003). Males tend to have higher rates of problem gambling than women (Shaffer et al., 1999) and most problem gambling studies find that males are more impulsive than female gamblers (e.g., Specker, et al., 1995). One study addressing gender differences in problem gambling defined it as a risk taking behaviour (Martins, Tavaresa, da Silva Loboa, Galettia, & Gentiless, 2004). In this study, the female problem gamblers had higher rates of suicide attempts, males had higher rates of risky sexual behaviour and substance abuse, while there were no gender differences in rates of illegal activities (Martins et al., 2004). There is, thus far, substantial evidence implicating impulsivity as playing an important role in the development and degree of severity of pathological gambling, at least in a subset of pathological gamblers.

Problems defining impulsivity in problem gamblers

One problem that has hampered the study of impulsivity in problem gamblers is a lack of consensus regarding the definition of impulsivity. Researchers have attempted to better understand the impulsive component of problem gambling by utilizing measures pertaining to sensation seeking (Blaszczynski, Wilson, & McConaghy, 1986), impaired control (Corless & Dickerson, 1989) and disinhibition (McCormick, 1993). Sensation seeking is a construct that is considered separate but related to impulsivity (Zuckerman,

1976). According to Zuckerman (1976), sensation seeking is comprised of a general component, a thrill and adventure-seeking component, an experience-seeking component, disinhibition, and boredom susceptibility. This overlap between sensation seeking and impulsivity led Eysenck and Zuckerman (1978) to outline impulsivity as having two factors: (i) impulsivity which is acting without thinking or acting without identifying possible risk factors and, (ii) venturesomeness, described as performing behaviours with awareness of possible risks.

The diagnostic validity of the inclusion of pathological gambling in the Impulse Disorder group has been debated with some researchers having argued that problem gamblers do not experience an "irresistible urge" and that many have control over their behaviour (Moran, 1970; McElroy, Hudson, Pope, Keck & Aizley, 1992; Allcock & Grace, 1988; Murray, 1993; Blaszczynski, Wilson, & McConaghy, 1986). Furthermore, in one study using measures of sensation seeking and impulsivity, pathological gamblers were not found to have higher impulsivity scores or sensation seeking scores compared to controls (Allcock & Grace, 1988). This may indicate that high levels of impulsivity are not a necessary component in the development of problem gambling or a sufficient causal mechanism in the absence of other types of symptomatology. It is important to note that Allcock and Grace (1988) used a sample of 10 problem gamblers and compared these with a sample of 25 controls. Their study may have had insufficient power to identify a significant difference between these two groups. Or, it may simply have been a case of sampling variation.

Defining the construct of impulsivity

While impulsivity currently remains a defining criterion of pathological gambling (APA, 2000), little research has been done to delineate the construct of impulsivity. Impulsivity has been operationalized in several ways including its being regarded as a personality characteristic (Eysenck & Eysenck 1977; Cloninger 1987; Gray, 1981; 1987; 1991), a physiological trait (Blanco et al. 1996; Comings, Rosenthal, Lesieur, & Rugle, 1996; Cherek, Moeller, Doherty, & Rhoades, 1997), and an aspect of ego functioning (McCormick, 1993). The specific types of behaviours that are included in self-report measures of impulsivity can vary considerably. For example, some pertain to the inability to delay gratification while others emphasize the speed of overall responding or the lack of planning and inability to restrain actions.

One popular definition of impulsivity as defined by many different theorists is "lack of thought". For example, Murray (1938) defined impulsivity as a tendency to respond quickly and without forethought. Evenden (1999) described it as premature responding which he defined as acting before all discriminating information is available. Buss and Plomin (1975) included failure to consider consequences in their definition. Barratt and Patton (1983) indicated that impulsivity is acting without adequate reflection, making quick decisions, and failing to plan ahead. Lastly, Eysenck, Pearson, Easting, and Allsop (1985) simplified the above definitions by describing impulsivity as acting without thinking.

Other aspects of impulsivity that have been highlighted include intolerance for delays in gratification (Evenden, 1999) and inability to restrain behaviour. This latter

component is also known as impaired control (Buss & Plomin, 1975) or as a lack of behavioural inhibition (Cherek et al., 1997).

Attempts at operationalizing impulsivity have incorporated many of the attributes described above. As such, impulsiveness has been conceptualized as a multi-dimensional construct (Gerbing, Ahadi, & Patton, 1987; Kindlon, Mezzacappa, & Earls, 1995). Impulsiveness has also been operationalized in terms of the number of different types of impulse-control incidents displayed such as substance abuse, criminal activities, fire setting, and repeated aggression (Stanford & Barratt, 1992). In contrast, Evenden (1999) argued that focusing on the behavioural manifestation of impulsivity instead of the underlying psychological processes could actually impede the study of impulsivity. Possible candidates for the position of underlying psychological processes are reward dependence and punishment avoidance. Blaszczynski and Nower (2002) hypothesized that the impulsive trait manifested in problem gamblers may relate to differential responses to reward and punishment. Impulsivity in this case may be defined as a greater desire to seek out rewarding activities and/or a dampened sensitivity to punishment.

Likely related to both the multifaceted nature of impulsivity and the multiple perspectives outlined above is the apparent lack, in problem gambling research, of adequate construct validity and replication. Most studies have utilized different measures of impulsivity. One purpose of this study will be to demarcate the core underlying construct of impulsivity by drawing out the common factor(s) within the above mentioned scales. The proposed underlying substrates of impulsivity, reward and punishment sensitivity may further enhance this demarcation of the impulsive common factor that these scales attempt to measure.

Emotional vulnerability as a predictor of problem gambling

Impulsivity, however, is not the only construct implicated in the development of pathological gambling (Blaszczynski & Nower, 2002). Emotional vulnerability, such as depression or anxiety, has been cited as a predisposing factor to the development of problem gambling (Moran, 1970; Roy, Custer, Lorenz & Linnoila, 1988; Lesieur & Rosenthal, 1991; Steel & Blaszczynski, 1996; Blaszczynski, 2002; Blaszczynski & Nower, 2002). Many researchers have postulated that gambling is a maladaptive coping response used to self-medicate depressive symptoms (e.g., McCormick, 1994; Getty, et al., 2000, Moran, 1970; Anderson & Brown, 1984; Blaszczynski, 2002; Blaszczynski & Nower, 2002). Israeli (1935) was the first to note relief from depression due to gambling although he described this relief, paradoxically, as occurring when the gambler lost all of his money. Fenichel (1945) described gambling as an effort to find relief from tension and hypothesized that gambling behaviour is perpetuated by extreme anxiety. Other early studies, describing the importance of depression, include Harris (1964) who reported a case study of a gambler who felt the urge to gamble whenever he became depressed and Niederland (1967), who described compulsive gambling as an attempt to ward off an impending depression.

More recently, McCormick (1994) identified high levels of negative affect and feelings of helplessness and hopelessness as features of relapse-prone gamblers. High rates of depressive disorders and anxiety disorders have also been found within samples of pathological gamblers (Blaszczynski & McConaghy, 1989; Getty, Watson & Frisch, 2000; McCormick et al., 1984; Petry, Stinson & Grant, 2005). High rates of depression have been found using the MMPI (Moravec & Munley, 1983; Graham & Lowenfeld,

1986; McCormick & Taber, 1988), the Beck Depression Inventory (Barnes & Parwani, 1987; Blaszczynski & McConaghy, 1988; Blaszczynski, et al., 1990), the Schedule of Affective Disorders (McCormick, et al., 1984), and the Symptom Check List-90 (Blaszczynski & McConaghy, 1988). Martinez-Pina, et al. (1991) found that depression discriminated pathological from non-pathological gamblers in a sample derived from the general population. In their study, 21.1% of the sample was currently depressed and depression was related to the severity of gambling addiction as assessed by the number of DSM-IV symptoms reported. Depression scores were also found to be highly correlated with trait anxiety. McCormick (1993) suggested that there might be a characterological component to the coexistence of depression and problem gambling and that this relationship may be better explained by a personality disorder.

Several authors have raised the question of the temporal relationship between onset of affective disorders and onset of problem gambling (McCormick et al., 1984). Stated differently, does depression lead to gambling as a means of escaping depressed feelings or do gambling losses lead to depression? In many studies, participants have reported periods where their mood was very depressed except when they were gambling (e.g., McCormick et al., 1984; Specker, et al., 1995). In these cases, gambling might be considered to have an antidepressant, energizing effect.

At least a subset of problem gamblers has been found to experience recurrent depression that precedes the development of the gambling disorder (Taber, McCormick & Ramirez, 1987). Graham and Lowenfeld (1986), using the MMPI, identified a depressive-reactive subtype of pathological gambler. McCormick (1994) and Castellani and Rugle (1995) found a chronic dysthymic group in their sample of problem gamblers.

Taber and colleagues (1987) found a greater history of life trauma and a negative attributional style in their sample of problem gamblers. Furthermore, these gamblers seemed to seek out the high arousal states offered by gambling. Ramirez, McCormick and Lowy (1988) looked at Dexamethasone (DST) suppression in pathological gamblers. Of the 21 participants, all showed DST suppression supporting the existence of a neuroendocrine correlate of depression in a dysphoric subtype of pathological gambler. They also showed that DST suppression is a predictor of recidivism after gambling treatment. These authors postulated that gamblers might attempt to cope with the distress that accompanies chronic hyper-reactivity of the Hypothalamic-pituitary-adrenal (HPA) axis by gambling. These studies found evidence for long-standing depressive and anxiety disorders that pre-existed the onset of gambling pathology.

An area of weakness in the body of literature is the limited examination of the impact of gender. Most of the research on problem gambling has used samples that were predominantly or solely male even though there is considerable evidence that females make up approximately one third of all pathological gamblers (Volberg, 1994). More recently, studies have attempted to include a more representative sample of female problem gamblers in their analyses. Getty, Watson, and Frisch (2000) found that females were significantly more depressed than males in a sample of problem gamblers. Another study found a significant gender difference for anxiety disorders (females 73% and males 16%) among problem gamblers and, when compared to controls, female gamblers showed consistently higher rates of Axis I mood disorders than female controls (Specker et al., 1996).

Depression and anxiety as predictors of gambling problems

In order to determine how depression and anxiety may influence the development of gambling problems, McCormick (1988) described two subtypes of gamblers, the chronically depressed gambler who sought the affect-enhancing excitement generated by gambling and the chronically understimulated (i.e., bored) gambler who needs varied stimulation and constant re-arousal. He found that the pathological gamblers in their sample obtained significantly higher boredom proneness scores and higher depression scores but not higher sensation seeking scores (McCormick, 1988).

Thus, researchers have proposed models that identify pathological gambling as a method of self-medication for anxiety and depressive disorders (Moran, 1970; Anderson & Brown, 1984; Blaszczynski, 2002; Blaszczynski & Nower, 2002). Anderson and Brown (1984) and Brown (1986) postulated that arousal state predicts gambling behaviour patterns. They further hypothesized that mood and anxiety disorders can be differentiated according to arousal state which may predispose an individual towards specific types of gambling behaviours depending on the particular disorder (Jacobs, 1986). According to their model, gamblers who are hypo-aroused or understimulated seek out gambling activities associated with high skill and excitement in order to increase their arousal state. As such, these gamblers would also likely score higher on measures of sensation seeking (Anderson & Brown, 1984; Brown, 1986). In contrast, those with high anxiety are likely to choose games requiring low skill in order to focus their attention and produce states of dissociation while those with high levels of depression may choose to augment their arousal level by choosing high skill games to combat their dysphoria (Jacobs, 1986). There has been some support for this hypothesis with findings that

depressed gamblers, particularly females, are more likely to choose modes of gambling that are socially isolating, repetitive or monotonous to modulate their mood state (Rosenthal & Lesieur, 1992; McCormick, 1994).

Other research, however, has indicated inconsistent findings with many studies failing to support Brown's (1986) hypothesis that gamblers have higher sensation seeking scores (Blaszczynski, Wilson & McConaghy, 1986) or differ in terms of sensation seeking and avoidance of dysphoric mood (Blaszczynski & McConaghy, 1989). Additionally, arousal theory was not supported in other research that focused on gambling as a coping mechanism to reduce depression and/or anxiety symptoms by type of gambling activity (Blaszczynski et al., 1986; McCormick et al., 1984). These studies sought to determine whether anxiety and depression scores differed depending upon the level of excitement generated and amount of skill needed for different types of gambling activities (e.g., poker machines vs. horse-racing). They did not find a significant difference between types of gambling activities by type of psychopathology (anxiety versus depression). These findings are, however, likely complicated by the high rates of comorbidity between anxiety and depression which makes it difficult to clearly differentiate between arousal states. For the most part, researchers tend to group anxiety and depression together into one subgroup of emotionally labile problem gamblers (e.g., Blaszczynski & Nower, 2002).

Positive and negative affectivity as predictors of problem gambling

As noted above, attempts to categorize subgroups of problem gamblers using arousal levels have likely failed due to the comorbidity of anxiety and depression. It may

be that a feature shared by both anxiety and depression may better explain the pathway leading to problem gambling behaviour in emotionally vulnerable individuals.

The constructs of positive and negative affectivity may account for the relationship between anxiety and depression. Negative affectivity has been identified as a psychological process that is shared jointly by both anxiety and depression (Clark & Watson, 1991). This construct may be able to address several questions including the comorbidity between anxiety and depression, differences in arousal state associated with different gambling activities, and phenotypic differences in these two disorders. As such, instead of attempting to distinguish pathological gamblers according to levels of depression and anxiety or grouping the two disorders together, aspects of pathological gambling may be better explained using the constructs of negative and positive affectivity.

According to Clark and Watson (1991)'s tripartite model, both anxiety and depression can be defined by a shared factor of general distress called negative affectivity and be differentiated by levels of positive affectivity and arousal level. Depression, according to Clark and Watson (1991) is characterized by high negative affect and low positive affect whereas anxiety is characterized by autonomic hyperarousal and high negative affect.

Negative affectivity has been described as an over-sensitivity to negative life events and is related to feelings such as hostility, guilt, and self-dissatisfaction as well as feelings of depression and anxiety (Clark, Watson & Mineka, 1994). High positive affectivity may be described as feeling a greater level of energy and "zest" for life (Clark & Watson, 1991). Such individuals tend to feel friendly, bold, assertive and joyful

whereas individuals with low positive affect tend to feel dull, flat and unenthusiastic (Clark, Watson & Mineka, 1994). According to Clark and Watson (1991), positive and negative affectivity are independent constructs. These two traits also have been linked to dominant personality dimensions. Positive affectivity is similar to extroversion and negative affectivity is linked to neuroticism (Tellegen, 1985; Watson & Clark, 1984).

Researchers have begun investigating the construct of negative affectivity as a possible mechanism underlying the emotional vulnerability in problem gambling. While positive and negative affectivity have not been directly addressed in gambling research, one study did include a correlate of negative affectivity and found it to be a good predictor of problem gambling. McCormick (1993) operationalized negative affectivity by using the NEO-PI-R (Costa & McCrae, 1985) factor of neuroticism. He found a significant difference between severity of problem gambling scores and this measure of negative affectivity. Positive affectivity has not yet been researched in samples of problem gamblers.

The relationship between impulsivity and negative affectivity

Most studies have attempted to outline the impulsive components of problem gambling using behavioural acts and have operationalized negative affectivity using psychiatric diagnoses. Ignoring the constructs that underlie these behaviours, however, may actually complicate the identification of the mechanisms that lead to the development of problem gambling.

Thus far, researchers have studied impulsivity and negative affectivity as constructs that independently lead to the development of disordered gambling (e.g., (Blaszczynski & Nower, 2002). However, a few efforts have been made to link these two

psychological processes. For example, Corless and Dickerson (1989), who define impulsivity as impaired control, link this construct with negative affectivity. They proposed that problem gamblers differ from social gamblers in terms of the role that negative affectivity plays in influencing their decisions to gamble. They identified the effects of depression and frustration as inciting problem gamblers to persist in gambling when losing thus proposing negative affectivity, in addition to impulsivity, as determinant of impaired control.

Furthermore, McElroy and colleagues (1992) provided an overview of the psychiatric comorbidity in the DSM-III-R Impulsive Disorders Not Elsewhere Classified. They cited the frequent occurrence of mood disorders in these individuals and discussed the apparent depressive symptom relief that these individuals obtain when engaging in the impulsive behaviour as those behaviours are related to their diagnosis (e.g., hair pulling in trichotillomania). Many researchers have attempted to directly link these disorders with mood disorders (see McElroy et al., 1992). Lastly, McCormick (1994) labelled problem gambling as a maladaptive coping response for depressive symptoms. Getty, Watson and Frisch (2000) linked this maladaptive coping to the impulsive characteristic of being unable to successfully "exhibit reflective, planful coping responses" (p. 379).

Gray's (1981, 1987) model provided a means of describing fundamental individual differences in both anxiety (negative affectivity) and impulsivity. Gray (1981, 1987) postulated the existence of two distinct motivational systems, appetitive and aversive. These systems have also been referred to as reward sensitivity and punishment sensitivity. The appetitive motivational system, also known as the Behavioural Activation

System (BAS), responds to the identification of positive reward stimuli by activating behaviour. Some have proposed that this system may also serve to activate behaviour in order to avoid punishment and seek relief (Fowles, 1987). Gray (1991), however, argued that avoidance responding is controlled to a greater extent by aspects of the positive reinforcement of safety cues rather than punishment. For example, a person with an overactive BAS would more frequently detect rewarding stimuli compared to those with an underactive BAS. Furthermore, when already primed for rewards, an overactive BAS would lead to more approach behaviours regardless of potential punishments.

The aversive motivational system, on the other hand, functions to inhibit behaviour and prevent frustration associated with non-reward. This system is more commonly referred to as the Behavioural Inhibition System (BIS; Gray, 1981; 1987). According to Gray (1981; 1987), the BIS is activated when a possible reward is paired with either a response-contingent punishment which may trigger negative emotions such as fear or anxiety, or cues indicating that a reward will not occur and approach will lead to frustration. An overactive BIS would result in a greater likelihood of preventing or inhibiting approach behaviours when in the presence of punishment while an underactive BIS would increase the chances of not inhibiting behaviours. Therefore, according to Gray's conceptualization, an underactive BIS would predispose people to have a lower sensitivity to punishment cues.

Researchers have described both impulsivity and anxiety using the BIS/BAS constructs. Gray (1981) proposed that impulsivity can be linked to either an overactive BAS or an underactive BIS. Using Gray's theory, impulsivity can be described as either an overactivation of behaviour (behavioural excess) leading to negative consequences or

a failure to inhibit a behaviour given foreseeable negative consequences (Fowles, 1987). This seems to fit with the "lack of thought" description of impulsivity described above. Furthermore, anxiety can also be directly related to the behavioural inhibition system (BIS) postulated by Gray (1982). High trait anxiety has been related to an overactive BIS system (Fowles, 1980). It seems, given the literature, that various combinations of the BIS and the BAS have been related to both levels of anxiety and impulsivity. However, there does not seem to be a clear-cut delineation of what patterns of each trait are needed to promote impulsive and anxious behaviours. Given the high rates of anxiety and impulsivity found in samples of problem gamblers, the BIS/BAS constructs may be key determinants in the development of problem gambling.

Cloninger's (1987) dimensional model of personality provides another interesting framework for the investigation of the relationship between affect, impulsivity and problem gambling from a neurochemical and biosocial perspective. According to this model, the three core temperaments are mediated by specific neurotransmitter systems: serotonin, norepinephrine and dopamine. The novelty-seeking temperament is believed to be directed by the dopaminergic system. This system directs novelty-seeking behaviour that is a heritable tendency towards intense exhilaration or excitement in response to novel stimuli, cues for potential reward or relief from punishment. This system, according to Cloninger, is considered to be the brain's "incentive" system (Cloninger, 1987). This system seems closely related to the BAS system proposed by Gray (1987). Harm-Avoidance is the second temperament described by Cloninger (1987). This trait is a heritable tendency to respond intensely to signals of aversive stimuli and learn to inhibit behaviours that elicit punishment, novelty and frustrative non-reward. He believes that

serotonin mediates this punishment system (Cloninger, 1987). This system seems closely related to the behavioural inhibition system (BIS) described by Gray (1987). Individuals scoring high on Harm Avoidance are described as worriers and this scale is purported to moderate reward-seeking behaviour (Cloninger, 1987). Reward Dependence, mediated primarily by the noradrenergic system, is the third system postulated. Cloninger (1987) links the noradrenergic system with this trait since it has been associated with learning and in the creation of paired associations. He suggests that these associations are necessary to associate stimuli with reward. Impulsivity, in Cloninger's model, is considered to be part of the broader personality dimension of novelty-seeking (Cloninger, 1987). Carver and White (1994), however, have argued that the novelty-seeking dimension does not closely enough relate to Gray's operationalization of impulsivity to be comparable. Corr, Pickering and Gray (1995) proposed that Cloninger's Reward Dependence may better fit with the BAS construct from Gray's model.

These motivational constructs (behavioural activation and inhibition) are purported to explain behavioural predispositions such as anxiety and impulsivity (Zelenski & Larsen, 1999). There is also considerable evidence linking them to affective experience. Gray's BAS and Cloninger's reward dependence (and possibly novelty-seeking) are both closely linked to positive affectivity. Similarly, Gray's BIS and Cloninger's harm avoidance are all closely linked to negative affectivity (Zelenski, & Larsen, 1999). The fact that these theories provide a more in-depth understanding of both impulsivity and negative affectivity through the conceptualization of reward and punishment may well contribute to an added understanding of the underlying psychological processes in problem gambling.

The role of personality disorders in problem gambling

Several personality disorders have been implicated as having important roles in the etiology of problem gambling (Blaszczynski & Steel, 1998). Personality disorders are typically defined as constellations of character traits and patterns of behaviour that are persistently maladaptive and lead to difficulties in functioning in interpersonal settings (APA, 2000). Axis II of the DSM-IV defines 10 different personality disorders. These 10 disorders are often grouped into three clusters based on descriptive similarities and considerable diagnostic overlap (APA, 2000). Cluster A includes the paranoid, schizoid and schizotypal personality disorders also known as the odd or eccentric cluster. Cluster B includes the antisocial, borderline, histrionic and narcissistic personality disorders, also known as the dramatic, emotional or erratic cluster. Cluster C includes the avoidant, dependent and obsessive-compulsive personality disorders, also known as the anxious or fearful cluster.

Personality disorders have been investigated in problem gambling research with most studies finding high rates of these diagnoses within samples of pathological gamblers (Blaszczynski & Steel, 1998; Specker et al., 1995). Blaszczynski and Steel (1998) found that 93% of the problem gamblers in their sample met criteria for at least one personality disorder, the majority of which were cluster B personality disorders, of which impulsivity and negative affectivity are key characteristics (APA, 2000). Blaszczynski, Steel, and McConaghy (1997) hypothesized a "multi-impulsive" personality disorder as being a key component to pathological gambling. Furthermore these authors suggest that the impulsive pathological gambler will differ from other pathological gamblers in level of impaired psychosocial and psychological functioning.

Relatedly, Antisocial Personality Disorder, for which impulsivity is a central feature, has been a major focus of research in this area (Blaszczynski & McConaghy, 1994). Studies have shown that between 14% to 40% of pathological gamblers meet criteria for antisocial personality disorder (McCormick et al., 1987; Blaszczynski & McConaghy, 1994; Carlton & Manowitz, 1994; Blaszczynski, McConaghy & Frankova, 1990; Bland, Newman, Orn, & Stebelsy, 1993). Blaszczynski et al. (1997) labelled this subgroup of problem gamblers "antisocial impulsivists" as they found very high correlations between measures of impulsivity and psychopathy proposing a uniform construct. Pietrzak and Petry (2005) found that pathological gamblers who met criteria for antisocial personality disorder had increased severity of gambling problems and an earlier age of onset relative to pathological gamblers without this diagnosis. Comorbid personality disorder diagnoses may further impact treatment type and duration (Petry, Stinson & Grant, 2005) as is the case with most comorbid axis I and axis II disorders. Blaszczynski and Steel (1998) further suggested that having a comorbid personality disorder indicates a likelihood of increased dysfunctional coping and increased treatment resistance. As with affective disorders, questions regarding the temporal relationship between gambling and antisocial personality disorder have been raised. Blaszczynski and McConaghy (1994) suggested that features of antisocial personality disorder may occur as a result of gambling behaviour as they found evidence to suggest that these characteristics are not always present before the onset of gambling problems.

Not all studies find antisocial personality disorder to be the most predominant. In one study, 87% of the sample met criteria for at least one personality disorder as assessed by the PDQ-4 (Black & Moyer, 1998). In this study the most frequent diagnoses were

obsessive-compulsive, avoidant and schizoid personality disorders (Black & Moyer, 1998). Petry, Stinson and Grant (2005) evaluated for 7 of the 10 personality disorders and found that 60.8% of their survey of pathological gamblers across 43, 093 households met criteria for a comorbid personality disorder. In this sample avoidant, dependent, paranoid, schizoid, and antisocial personality disorders were all predictive of psychosocial disability. Steel and Blaszczynski (1998) expanded the notion of the impulsive subtype of problem gambler to include other cluster B and three cluster C personality disorders (dependent, avoidant and passive-aggressive personality disorders). In a different study, Specker and colleagues (1996) found that personality disorders were diagnosed in 25% of the problem gamblers in their sample. They commented that based on the inclusion of pathological gambling in the impulse control disorder category, Cluster B (the acting out cluster) of the personality disorders should be the most common group of personality disorder diagnoses. None of the problem gamblers in their sample, however, met criteria for antisocial personality disorder. Avoidant personality disorder was the most common at 12.5%; narcissistic, dependent and obsessive-compulsive personality disorder were all 5%; and paranoid, schizoid and borderline were 2.5%. Cluster C personality disorders (the anxious fearful cluster) were the most commonly diagnosed, accounting for 17.5% of all pathological gamblers.

Interestingly, Petry, Stinson and Grant (2005) found that rates of pathological gambling in individuals with personality disorders were similar to rates in samples of substance users, and with mood and anxiety disorders. Alternatively, Blaszczynski and Steel (1998) found that rates of personality disorder diagnoses within samples of pathological gamblers were similar that the rates found in general psychiatric

populations. This indicates that having a personality disorder may not increase the risk of developing a gambling problem but is likely to exacerbate the severity of a gambling problem.

Thus far, the relationship between personality disorders and problem gambling remains unclear. While there are likely antecedent personality factors that exist prior to the development of problem gambling, there is extensive overlap between the constructs of impulsivity and negative affectivity with the cluster B and C personality disorders. There may, however, be aspects of personality psychopathology that are not fully accounted for by impulsivity and negative affectivity such as those related to narcissistic personality disorder. Steel and Blaszczynski (1998) postulated that this personality disorder, along with antisocial personality disorder, may be mediators of the severity of problem gambling behaviour and may also hinder response to treatment. Whether the long-standing interpersonal problems that define personality disorders can account for variance in problem gambling severity above and beyond impulsivity and negative affectivity has yet to be determined.

Statement of Purpose

The purpose of this study is to better understand the role of personality disorders in the development and exacerbation of problem gambling. Core temperament constructs including impulsivity, negative affectivity and sensation seeking have been linked to the development of problem gambling. These constructs may fully account for the comorbidity between problem gambling and many personality disorders. However, questions remain as to how personality disorders might be best integrated into this conceptualization. Research has shown that personality disorders from all three clusters

are prevalent in problem gambling. Are extreme scores on either negative affectivity or impulsivity sufficient to account for the relationship between personality disorders and problem gambling? Or rather, are there other aspects within personality psychopathology that exacerbate the severity of problem gambling? If so, this would indicate that presence of personality psychopathology may exacerbate the severity of problem gambling and should be addressed with regards to treatment issues.

Furthermore, there are inconsistencies in how the temperament constructs are defined and operationalized. This study will attempt to identify the core constructs underlying emotional vulnerability (negative affectivity), impulsivity and personality psychopathology by combining numerous scales all purporting to measure the same construct. Thus far, these constructs have never been empirically tested in one model.

The current trend in the problem gambling literature is to develop gambling typologies and attempt to group problem gamblers into one of multiple categories. However, constructs such as impulsivity, negative affectivity and personality psychopathology may preclude the formation of distinct categorization since many dimensional models of personality, such as Gray's behavioural inhibition and activation systems (1981; 1987), can encompass two or more of these constructs. As such, it would be informative to determine the interrelation between these three different possible etiological mechanisms in the development of problem gambling.

Building upon the body of literature described above, two primary questions were addressed in this study. First, this study tested which set of variables, the temperament variables or the personality disorder variables contributed the most incremental variance

to problem gambling. Second, gender was tested as a possible mediator of these relationships.

Hypotheses

Primary hypothesis:

1. It is hypothesized that, while the temperament variables will likely account for much of the relationship between personality psychopathology and problem gambling, the personality disorder variables will contribute unique variance to the model.

Secondary Hypothesis:

2. It is hypothesized that gender will moderate the relationship between impulsivity and negative affectivity with problem gambling. Given the results of previous research, impulsivity is expected to be a stronger predictor of problem gambling for males and negative affectivity a stronger predictor for females. If this holds true, controlling for gender may provide additional predictive strength for the temperament variables when testing the interrelation between the temperament variables and the personality disorder variables as predictors of problem gambling severity.

METHOD

Participants and Procedure

Two different samples were used to test the hypotheses posited in this study. A sample of problem gamblers was pulled from a larger study investigating mechanisms of disinhibition. Problem gamblers were actively recruited for this study through various referral sources for a period of 2 years and required a 5-hour protocol per participant. The second sample was comprised of student gamblers chosen both for reasons of applicability and accessibility. Ladouceur, Dube and Bujold (1994) reported that problematic gambling behaviour is likely to emerge during late adolescence and during college. The prevalence rate for problem gambling in student samples is approximately 15% (Lesieur et al., 1991; Lightsey & Hulsey, 2002) with three times higher rates for males compared to females (Lightsey & Hulsey, 2002). As such it appeared appropriate to use this type of sample to further test the hypotheses related to this study. Furthermore student samples are readily accessible and allow for the recruitment of larger sample sizes with decreased financial and time costs. This sample may also allow for a greater generalizability of factors that influence the development of gambling problems prior to clinical significance.

In the *student* sample, participants were 116 male and 370 female undergraduate students (for a total sample size of 486) at the University of Windsor in Ontario, Canada. Participants were randomly recruited through a participant pool comprised of students in undergraduate psychology courses offered at the university. Participants obtained partial course credit for participating in this study. All questionnaires were re-created in a password-protected website as part of a larger personality study. The website was

developed to provide a convenient way for students to complete the lengthy questionnaires and was accessible only with a username and password. Participants provided informed consent by submitting a form on the website and were asked to complete all of the questionnaires within a one-week period, before their username and password expired. The mean age of the participants was 21.8 years (SD = 4.4) ranging from 17 to 50, and there was no significant difference in age by gender. From the sample, 323 (66.5%) participants described themselves as Caucasian or White; 18 (3.7%) as African, Caribbean or Black; 17 (3.5%) as East Indian or South Asian; 14 (2.9%) as Arabic; 18 (3.7%) as Asian; 44 (9.1%) as Western European; 13 (2.7%) as Eastern European; 2 (0.4%) as Native Indian or Inuit; 29 (6.0%) as Canadian; and 8 (1.6%) reported another ethnicity. Most of the students, 430 (88.5%), described themselves as single, 25 (5.1%) as married, 24 (4.9%) as common-law and 8 (1.4%) as divorced. Almost half of the participants 217 (44.7%) were in their first year of university; 111 (22.8%) were in their second year of university; 75 (15.4%) were in their third year of university; 42 (8.6%) were in their fourth year of university; and 41 (8.4%) reported having completed a college diploma prior to starting university.

In the *referred* sample of problem gamblers, participants were 39 males and 58 females who were recruited from a Southern Ontario mid-sized city (for a total sample size of 97). These participants were drawn from a larger research project that received ethics approval in spring 2003 from the University of Windsor Research Ethics Board and Research Ethics Boards of referring agencies. Participants were recruited over a three-year period from community referral sources including clinics, the Salvation Army, and support agencies as well as from the undergraduate participant pool at the University

of Windsor (see Appendix B for recruitment poster). This study was part of a larger project consisting of 125 participants investigating mechanisms of disinhibition in impulsive populations (i.e., ADHD, Bulimia, Borderline Personality Disorder, and Substance Abuse). All potential participants participated in a telephone screen to determine if they experienced any problems related to their gambling. If participants endorsed even one item on the Sullivan's (2001) brief problem gambling screening questionnaire (see Appendix D), they were invited to participate. Participants in this sample were given $60 CDN for participation, or, if they were recruited through the participant pool, partial course credit and $30 CDN as the overall study required 5 hours to complete the research protocol. The mean age of the participants was 28.7 years (SD = 12.69) ranging from 18 to 74, and there was no significant difference in age by gender. In this sample, 26 (27.1%) participants described themselves as Caucasian or White; 11 (11.5%) as African, Caribbean or Black; 2 (2.1%) as East Indian or South Asian; 2 (2.1%) as Arabic; 1 (1.0%) as Asian; 33 (34.0%) as Western European; 7 (7.2%) as Eastern European; 8 (8.2%) as Native Indian or Inuit; 5 (5.2%) as Canadian; 1 (1.0%) reported another ethnicity; and one participant refused to answer the demographic questions. Of the *referred* participants, 71 (73.2%) described themselves as single; 9 (9.3%) as married; 6 (6.2%) as common-law; 1 (1.0%) as widowed; and 10 (10.3%) as divorced. More than half of these participants, 53 (54.6%) reported completing some post secondary schooling; 20 (20.5%) completed a post secondary degree or diploma; 6 (6.2%) completed secondary school; and 3 (3.1%) reported only completing some high school. The remaining 15 (15.5%) participants in this sample did not report their education level.

Measures

To successfully identify the underlying factor structure of a set of variables, it has been recommended to include a minimum of three to five variables relating to each hypothesized construct (Velicer & Fava, 1999). To accomplish this, numerous variables relating to the constructs of impulsivity, sensation-seeking as well as negative and positive affectivity were included in this study. Measures of reward and punishment sensitivity have also been purported to relate to both impulsivity and affectivity. As such, reward and punishment sensitivity were included with the intent of better delineating these constructs using measures other than behavioural report (as is the case with many commonly used impulsivity measures). Only two measures of personality disorders were included due to space limitations. Previous findings have identified high communalities between the loadings of personality disorder scales across these two measures (Carroll, 2002).

The Beck Anxiety Inventory (BAI: Beck, Epstein, Brown & Steer, 1988) is a 21-item self-report inventory developed to measure anxiety severity over the past week. Items are rated on a 4-point Likert scale from *not at all* to *I could barely stand it.* This inventory has good internal consistency with a Cronbach's alpha of .91 (Beck & Steer, 1991).

The Beck Depression Inventory, version II (BDI-II; Beck, Steer & Brown, 1996) is a 21 item clinically derived self-report instrument for assessing current depression severity for the past two-week period. According to Carlson (1998), this inventory taps more of the cognitive and cognitive-affective components of depression than most other measures. The internal consistency for this inventory has been tested in multiple studies with coefficient alpha scores ranging from .76 to .95 (Beck, Steer & Garbin, 1988). This

inventory is a state measure of depression and therefore test-retest reliability coefficients are not reported.

Barrett Impulsiveness Scale, version 11 (BRT-11; Patton, Stanford & Barratt, 1995) is a 64-item self-report questionnaire designed to measure impulsivity. All items are measured on a 4-point scale (rarely/never, occasionally, often, almost always/always). According to Barratt (1985), impulsivity is comprised of three subtraits, a motor component, a cognitive component and a non-planning or motivational component. Accordingly, the first factor relates to behaviours (e.g., acting without thinking), the second pertains to the speed of making decisions and the third is associated with a lack of future orientation. The Cronbach's alpha for the BIS-11 in different samples ranges from .79 to .83 (Patton, Stanford & Barratt, 1995).

The Behavioral Inhibition System/Behavioral Activation System Scales (BIS/BAS Scales; Carver & White, 1994) is a 20-item self-report measure using a 4-point Likert scale. These scales were designed to measure dispositional BIS and BAS sensitivities according to Gray's neuromotivational theory. Items are responded to on a 4-point Likert scale. Internal consistency for the BIS subscale has been described as decent with a coefficient alpha of .74 and a test-retest Kappa value of .66 (Carver & White, 1994). Internal consistency for the BAS reward responsiveness subscale is reported to be similar with a coefficient alpha of .73 and a test-retest Kappa value of .59 (Carver & White, 1994). Internal consistency for the BAS subscales (reward responsiveness, drive and fun-seeking) ranged from .66 to .76. These three subscales were combined into one BAS scale (Carver & White, 1994). This measure has also been shown to have good criterion-related validity as well as predictive validity (Carver & White, 1994).

The Conners' Adult ADHD Rating Scale (CAARS; Conners, et al., 1999) is a 66 item self-report questionnaire of Attention Deficit Hyperactivity Disorder in adults. Items are responded to using a 4-point Likert scale. This measure contains four subscales: inattention/memory, hyperactivity, impulsivity, and poor self-concept. This measure is considered to have good psychometric properties. In terms of internal consistency, Cronbach's alpha coefficients range from .86 to .92 and test-retest reliability kappa coefficients range from .80 to .91 (Conners, Erhardt et al. 1999). This measure has also been shown to have good criterion-related validity as well as predictive validity (Conners, Erhardt et al. 1999).

The DSM-IV Pathological Gambling Criteria (APA, 2000). Pathological gambling is diagnosed when five or more of the 18 criteria presented in the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV-TR) are endorsed and the gambling behaviour is not better accounted for by a Manic Episode.

The Generalized Reward and Punishment Expectancy Scale (GRAPES; Ball & Zuckerman, 1990) consists of 30 items relating to the reward and punishment that individuals expect for their behaviours. Fifteen items on this scale relate to reward expectancy and the other 15 items relate to punishment expectancy. Each self-report item of the GRAPES is answered as either *true* or *false*, with higher scores indicating higher expectancy levels. According to Ball and Zuckerman (1990), the reward expectancy scale is a measure of BAS strength, and the punishment expectancy scale is a measure of BIS strength. Ball and Zuckerman (1990) reported Cronbach's alpha coefficients of .63 and .60 for the reward and punishment expectancy scales, respectively.

The I7-Impulsiveness Questionnaire (Eysenck, Pearson, Easting, & Allsopp, 1985) is a 54-item self-report questionnaire. Each item is answered as either *yes* or *no*. This questionnaire consists of three subscales: impulsiveness, venturesomeness, and empathy. For the purpose of this study, participants only completed questions associated with the impulsiveness and venturesomeness dimensions. In this measure, the impulsivity scale pertains primarily to a failure to evaluate risk while the venturesomeness scale pertains to behaviour in which the risk is perceived but the action is still completed. The reported internal consistency coefficients for the impulsiveness scale are .84 in males and .83 in females and for the venturesomeness scale .85 in males and .84 in females (Eysenck, et al., 1985).

The Millon Clinical Multiaxial Inventory, version III (MCMI-III; Millon, 1994) is a 175 item is answered as either *true* or *false*. This measure is considered to be a comprehensive assessment device of the major forms of Axis II psychopathology. The development of the MCMI used a combination of rational theory-based as well as empirical procedures (Groth-Marnat, 1997). The development was guided by Millon's theory of personality that states that personality can be described using the polarities of pleasure-pain, active-passive and self-other (Millon & Davis, 1996). An important feature of this measure is that personality disorders are not considered to be mutually exclusive; as such many of the scales can be expected to be highly correlated (Groth-Marnat, 1997). This measure has been widely validated and is extensively used in clinical settings. For the MCMI-II, alpha coefficients are greater than .80 for 20 of the 26 scales, which range from .66 to .90 (Goncalves et al., 1994). Studies of the test-retest reliability of this measure have only been performed for shorter intervals (two weeks or less). The test-retest reliability ratings

ranged between .82 and .96 (Goncalves et al., 1994). Validity studies using factor analysis on previous versions of the MCMI support the organization of the scales (Millon, 1987).

The Positive and Negative Affect Schedule (PANAS; Watson, Clark & Tellegen, 1988) is a 20-item self-report questionnaire developed to measure trait positive affectivity (PA) and trait negative affectivity (NA). Ten emotions have been associated with each of these subscales such as *interested* and *excited* for PA, and *distressed* and *upset* for NA. For each item on the test, participants rate the extent to which each emotion is generally experienced on a 5-point scale ranging from 1 (very slightly or not at all) to 5 (extremely) in the past year. Total scores range from 10 to 50 for both PA and NA, with higher scores reflecting greater levels of PA and NA. Internal consistency reliability estimates for trait PA was reported as .88 and trait NA as .87, with test–retest reliability at an 8-week interval being .68 and .71, respectively (Watson, Clark & Tellegen, 1988).

The Personality Diagnostic Questionnaire, version 4+ (PDQ-4+; Hyler et al., 1988) is the most current version of this well validated scale for assessing the personality disorders in the DSM-IV. It consists of a 99 items, self-administered questionnaire designed to yield diagnoses consistent with the DSM-IV (APA, 1994). The items in this questionnaire are answered as either *true* or *false* and correspond to individual criteria and the instrument yields both dimensional and categorical scores. The PDQ-4+ has demonstrated internal consistency coefficients ranging from .46 to .74 for the 12 personality disorders (including Passive-Aggressive and Depressive). This measure has also been validated as a self-report personality disorder diagnostic tool through comparisons with structured personality disorder interviews.

Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001), is a 9-item index which has good reliability and validity. The Cronbach's alpha coefficients for this PGSI component of this index show good internal consistency at .84 (Wynne, 2003). The Pearson Product-Moment coefficients calculated to assess test-retest reliability was .78 (Wynne, 2003). The PGSI has also been demonstrated to have good content validity and good concurrent validity with the DSM-IV criteria items and SOGS (Lesieur & Blume, 1987). These items assess problem gambling using questions related to problem gambling behaviour, consequences of these behaviours and problem gambling severity. This scale was pulled from the Canadian Problem Gambling Index (CPGI; Ferris & Wynne, 2001), which is a 129-item measure of problem gambling for use in general population surveys. Once the 9 items are summed, participants are assigned to one of four groups (non-problem gambling, low-risk gambling, moderate risk gambling, and problem gambling). The South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987) contains 16 items that are summed together to create a total score to determine degree of problem gambling severity. Scores are grouped into three categories with 0 = "no problem", 1-4 = "some problem," and 5 or more = "probable pathological gambler". Three other questions are included in the SOGS that are not tallied in the final score but do provide additional information. One question pertains to number and frequency of gambling activities, another to the amount of money spent on gambling activities and the third on significant relationships with people who have gambling problem (e.g., family and friends). The Cronbach's alpha coefficients for the SOGS show good internal consistency at .97 (Lesieur & Blume, 1987).

The Tridimensional Personality Questionnaire (TPQ; Cloninger, 1987) is a 100-item inventory where items are answered as either *true* or *false*. The instrument measures three personality dimensions, Novelty Seeking, Harm Avoidance and Reward Dependence. Each dimension consists of four lower-order dimensions. Cronbach's alphas have been reported to range between .77 and .85 for Harm Avoidance .68 and .75 for Novelty Seeking, and .61 and .69 for Reward Dependence (Cloninger, Przybeck, & Svrakic, 1991). This measure is also reported to have good test-retest reliability with correlations of .70 for Reward Dependence, .76 for Novelty Seeking, and .79 for Harm Avoidance. When administered to a sample of 101 medical students, Cloninger reported normal distributions on all three scales consistent with other validated measures administered concurrently (Cloninger, Przybeck, & Svrakic, 1991).

The Urgency, Premediation, Perseverance, and Sensation Seeking Impulsive Behaviour Scale (UPPS; Whiteside & Lynam, 2001) is a 45-item inventory where items are answered as either *true* or *false*. This self-report scale is purported to measure four distinct components of impulsive behaviour. This scale was derived through factor-analytic methods to measure four distinct factors of impulsivity. The UPPS consists of four subscales, urgency, (lack of) premeditation, (lack of) perseverance, and sensation seeking. The internal consistency coefficients for these four factors range from .82 to .91.

Development of PGOUT problem gambling severity scale

The use of multiple measures of the same construct is regarded as a preferable methodological strategy in research as the aggregation of measures usually serves to increase the measurement reliability and construct validity of a variable. While there is not, as of yet, a gold standard for measuring problem gambling (likely because there is

not yet consensus on what exactly problem gambling is), three measures that have been frequently used in the literature and judged to have good reliability were included as scales in the student sample. These are, the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987), the Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2000), and the DSM-IV criteria for Pathological Gambling (APA, 2000).

In addition to items pertaining to gambling problems, the SOGS also contains a list of different types of gambling activities (e.g., cards, races, etc.) and asks the respondents to endorse for each of these how often they have gambled in that activity over their lifetime and over the past 12 months. While these two items are not normally tallied into the final SOGS problem gambling severity scale (Lesieur & Blume, 1987), and are usually used separately to provide additional descriptive information, these items will be examined to see if they provide incremental predictive validity to the problem gambling construct and may be included in the final problem gambling amalgamated variable.

It is possible that a measure of problem gambling severity would be skewed to a greater degree in a student sample. To increase variability and address areas of problem gambling that may not have been adequately operationalized by existing items, five items were written for inclusion as part of the dependent variable pertaining to the mood effects of gambling (these items will be referred to as the PG5 from this point on; see Table 1 for list). In addition, three of these items have a five choice response format, and as such, they offer the opportunity to increase the range of the problem gambling dimension. Thus, there were 6 different scales, including the two lists of types of gambling engaged

in (SOGS; Lesieur & Blume, 1987) that were included to be combined together to create a dependent variable.

Table 1

Additional items for student problem gambling outcome measure (PG5) with weightings

Considering any of the above forms of gambling that you have participated in, please answer the following questions:		
a.	How exciting do you find gambling?	(1) Very boring (2) Slightly boring (3) Neutral (4) Somewhat exciting (5) Very exciting
b.	How does gambling usually affect your mood?	(1) Makes me depressed (2) Makes me feel down (3) Does not affect my mood (4) Makes me feel good (5) Makes me feel great
c.	How well does gambling distract you from your problems?	(1) I focus more on my problems when I gamble (3) It doesn't distract me at all (5) It really distracts me from my problems
d.	How much do you enjoy being in a gambling environment (i.e., being at the casino, watching a horse race or checking the lottery results)	(1) Hate it (2) Don't mind it (3) Neutral (4) Like it (5) Love it
e.	How easy is it to stop gambling once you have started?	(1) No problem, I know my limits (3) Somewhat difficult, I always want to play "one more" (5) Really difficult, I usually spend more than I planned to

RESULTS

Creation of the dependent variable in the student sample

The Chronbach's Alpha internal consistency estimate for the PG5 data is .71. The item means for these 5 items ranged from 1.4 to 3.4. Items a, b, and d have five multiple choice options. However, items c and e only have three options. Therefore, the weighting for these items were altered to ensure that they were equivalent to the other three items in the PG5 scale (see weightings in Table 1). Since the new scale is considerably shorter than the other problem gambling severity scales in this sample, it is possible to estimate its reliability if it were of approximately equivalent length to the other problem gambling severity scales (i.e. three times longer). Using the Spearman-Brown Prophecy formula (Anastasi & Urbana, 1997), the internal consistency for this scale if it were 15 items in length as opposed to five items is estimated at .88.

The data collected using the 13 SOGS items returned a Chronbach's alpha of .75. The item means for this scale ranged from .01 to .12. The Chronbach's alpha for the data collected using the DSM-IV items is .89 with item means ranging from .00 to .06. Lastly, the Chronbach's alpha for the PGSI data is also .89 with item means ranging from .04 to .18. The correlations among the four scales as well as the two frequency items (lifetime gambling activities and past year gambling activities) indicate that the PGSI, DSM-IV and SOGS are highly correlated. The strongest relationship is between the PGSI and the DSM-IV ($r = .81$). The PG5 scale is only moderately correlated with the other three scales (see Table 2).

Table 2

Correlation analysis among problem gambling severity scales and activity items

Scale	Lifetime	Past year	SOGS	DSM-IV	PGSI	PG5
Gambling freq. lifetime	1					
Gambling freq. past year	.759**	1				
SOGS	.263**	.311**	1			
DSM-IV	.174**	.238**	.752**	1		
PGSI	.189**	.288**	.804**	.810**	1	
PG5	.399**	.420**	.467**	.407**	.462**	1

*$p < .05$. **$p < .01$.

Using the PGSI, Ferris and Wynne (2001) suggest that a score of 0 indicates no risk of problem gambling, a score of 1 or 2 identifies a low-risk for problem gambling, 3 to 7 identifies a moderate risk for problem gambling, and 8 or higher identifies problem gamblers. In the student sample, 13 (2.65%) out of 486 students can be classified as problem gamblers. A diagnosis of pathological gambling can be made if 5 or more of the DSM-IV criteria are endorsed. In the student sample, 14 (2.86%) participants met criteria for pathological gambling according to DSM-IV criteria. Using the original SOGS scoring and items, 19 (3.88%) endorsed sufficient items to be classified as "probably pathological gambler" (Lesieur & Blume, 1987).

An investigation of the five additional items written especially for this study indicated that as a group, they were not useful for the intended purpose of better operationalizing problem gambling severity. Each item was analysed by first considering the response options to define groups of respondents. For example, item 1 had five response options that theoretically should indicate increasingly severe problem gambling

symptomatology. If this were so, then individuals who marked response option 1 should have the lowest scores on the three measures of problem gambling severity, and those who endorsed response options 2, 3, 4, and 5, respectively, should have mean scores on the problem gambling measures that increase linearly, even if not exactly monotonically. An ANOVA was used to determine if the options for each item differentiated between different "levels" of problem gambling in a dimensional fashion as do the other scales by using the three validated scales as dependent variables. For the first item "How exciting do you find gambling?", ANOVA results indicated that this item did significantly differentiate between levels of problem gambling (PGSI: $F(4, 485) = 26.34, p < .001$; DSM: $F(4, 485) = 22.73, p < .001$, SOGS: $F(4, 485) = 24.82, p < .001$), however, post hoc analyses using the Scheffe procedure (this post hoc procedure was selected as it is robust against differing sample sizes as is the case among the response rates for these items) identified only the fifth option "Very exciting", as differing from the other options (for all three scales). The first four options for this item all returned similar means on the three scales, indicating that the item means for each level of item do not increase monotonically.

For the second item "How does gambling usually affect your mood?" ANOVA results indicated that this item also significantly differentiated between levels of problem gambling (PGSI: $F(4, 485) = 8.18, p < .001$; DSM: $F(4, 485) = 9.12, p < .001$, SOGS: $F(4, 485) = 12.59, p < .001$), however, post hoc analyses using the Scheffe procedure indicated that those who endorsed the third response option, "Does not affect my mood", scored significantly lower on the problem gambling measures. These scores were not only lower than those who endorsed the last response "makes me feel great", but were

also significantly lower than those who endorsed the first response option "makes me depressed". This suggests that across the response options selected for this item, the problem gambling measures' mean scores formed a "U" shape in which both those participants who endorsed "makes me depressed" and "makes me feel great" had significantly higher problem gambling scores than those who endorsed the middle option, "does not affect my mood". This item, given this consideration, is not a linear predictor of problem gambling.

The third item "How well does gambling distract you from your problems?" was likewise investigated. As before, groups were formed using endorsements of response options to define the groups and the response options should have (ideally) classified the respondents into groups with monotonically increasing problem gambling scores. ANOVA results indicated that this item also significantly differentiated between levels of problem gambling (PGSI: $F(2, 487) = 33.73, p < .001$; DSM: $F(2, 487) = 39.67, p < .001$, SOGS: $F(2, 487) = 28.73, p < .001$). Post hoc analyses using the Scheffe procedure, however, again identified a "U" shaped pattern among problem gambling severity mean scores for all three scales. Again, those endorsing the middle option, "it doesn't distract me at all", had significantly lower problem gambling severity scores on all three scales than did those who endorsed either higher or lower response options. Thus, this item is not indicative of monotonically increasing levels of problem gambling across the response options.

For the fourth item "How much do you enjoy being in a gambling environment?", ANOVA results indicated that this item did significantly differentiate between levels of problem gambling (PGSI: $F(4, 485) = 39.14, p < .001$; DSM: $F(4, 485) = 38.29, p < .001$,

SOGS: $F(4, 485) = 32.71, p < .001$). Again, post hoc analyses using the Scheffe procedure identified only the fifth option "Love it", as differing from the other options (for all three scales). The first four options for this item all returned similar means on the three scales, indicating that this item is not dimensional in nature.

Only the last item "How easy is it to stop gambling once you have started?" significantly grouped participants into groups with monotonically increasing levels of problem gambling severity. ANOVA results indicated that this item significantly differentiated between levels of problem gambling (PGSI: $F(2, 487) = 158.03, p < .001$; DSM: $F(2, 487) = 112.79, p < .001$, SOGS: $F(2, 487) = 99.94, p < .001$). Post hoc analyses using the Scheffe procedure identified significant differences between all options for all scales ($p < .001$). Given that only one of the five items predicted problem gambling severity in a linear, dimensional fashion, these items were not included in the development of the final problem gambling severity measure. Therefore, while there were some significant differences between the means for some, but now all choices for the above items, there was no evidence for a linear trend in any of them. Examination of Table 2 above shows that the three problem severity scales have moderately high correlations with each other (ranging from .75 to .81). This indicates that these scales are likely measuring the same general construct. Because the two items pertaining to type and frequency of gambling activities have low moderate correlations with these three scales, these items cannot themselves be considered measuring a comparable construct. On the other hand, it is reasonable to ask whether the three problem gambling severity scales are entirely redundant. If each measures some unique variance in one of the others, then none is entirely redundant.

The scales were explored to determine if any of them provided unique variance above and beyond the other measures. In order to ascertain this, three regression analyses were performed with each of the three problem gambling severity scales used as the dependent variable and the other two scales and two frequency items were entered into the regression equation using backwards entry.

For each regression equation where, in turn, the three scales (PGSI, DSM-IV, and SOGS) were utilized as the dependent variable, all other scales (including the lifetime and past year frequency variables along with two of the problem gambling severity scales) contributed unique variance to the equation. Upon further investigation, however, the two frequency scales presented mixed findings. When used as predictors of the PGSI (along with the DSM and SOGS scales), the overall model was significant ($F(4, 485) = 314.03, p < .001$) and the past year frequency variable was a significant positive predictor ($\beta = .126$ $t = -3.36, p = .001$). The lifetime frequency variable, however, was a significant negative predictor ($\beta = -.086$ $t = -2.32, p = .021$) indicating that the more gambling activities engaged in over the participant's lifetime, the less severe their gambling problems are. This finding does not support the inclusion of this variable into the final outcome measure. When the DSM-IV scale was used as the dependent variable, the overall model was again significant ($F(4, 485) = 319.02, p < .001$) however neither frequency variable (lifetime or past year) was a significant predictor. When the SOGS was used as the predicted variable, the model was again significant ($F(4, 485) = 301.68, p < .001$). In this case, only the lifetime frequency variable was significant ($\beta = .100$ $t = 2.58, p = .010$) along with the other two problem gambling severity scales. Given that the two frequency variables were not consistent predictors of problem gambling severity and,

in one case, was a significant negative predictor, these two items were not included in the final problem gambling dependent variable.

Given the above findings, in order to improve both reliability of measurement and breadth of construct coverage, the three scales were then combined together to form one amalgamated measure. Because response options differ between the scales, however, they could not be simply added together. In order to combine the scales, they were first standardized before they were summed to create an amalgamated problem gambling severity scale.

This amalgamated scale was called PGOUT (Problem Gambling OUTcome questionnaire). The descriptive statistics for this variable indicate the measure is significantly positively skewed and kurtotic (skewness = 4.74, S.E. = .110; kurtosis = 27.28, S.E. = .220). Next, this variable was examined for potential outliers. Only eight of the participants had scores that corresponded to $z > 3.29$. This is to be expected given the sample size (Tabachnick & Fidell, 2001). These eight scores were truncated to have a z score of 3.24 (a PGOUT value of 1.08).

The PGOUT was created for and only available for the student sample, not the community referred sample. To facilitate comparisons of analyses across both samples, for the student sample, we report results using the PGOUT and the PGSI, which is the sole index of problem gambling in the referred sample. However, because of its higher reliability and its broader construct coverage, the PGOUT is clearly the better measure.

Descriptive statistics

Prior to analysis, the variables were all examined for missing values and assumptions of normality. There were very few missing items in the raw data in both

datasets (less than 1% of both raw and scale scores) and these were replaced with the item mode before the variables were scored. There were no identifiable patterns in the missing data apart from participants who failed to complete entire questionnaires due likely to time constraints (in the *referred* sample), computer problems or a decision to end participation part way through administration. Participants in the *student* sample were awarded their partial course credit upon completion of the consent form, even if they did not complete all of the questionnaires. Only participants who completed all of the questionnaires in the *student* sample were included in the analyses. Participants with missing questionnaires were included in the *referred* sample when computer error, administration error, or time constraints prevented completion of all questionnaires; this led to differing sample sizes for each hypothesis tested. Table 3 contains the descriptive data for the variables in both samples.

Table 3

Descriptive statistics for both the student sample (n=486) and the referred sample (n=80)

Scale	Student Sample		Referred Sample	
	Mean	Std. D.	Mean	Std. D.
Impulsivity variables:				
BARRATT Non-Planning	25.63	4.60	27.70	5.05
BARRATT Cognitive	25.12	4.10	25.04	4.07
BARRATT Motor	23.51	4.96	24.23	4.89
CAARS B (Hyperactive/Restless)	12.81	6.10	15.23	6.48
CAARS C (Impulsivity/Emotional)	10.27	5.76	12.85	6.29
CAARS F (Hyperactive/Impulsive Sx)	8.12	4.45	10.01	4.52
GRAPES Reward Expectancy Scale	7.34	3.26	6.81	3.34
GRAPES Punishment Expectancy Scale	7.56	2.98	7.96	2.98
I7 Impulsivity	25.91	4.18	28.03	4.72
I7 Venturesomeness	24.79	3.63	24.39	3.90
UPPS lack of Premeditation	3.13	3.04	3.75	3.34
UPPS Urgency	5.42	3.64	7.54	3.57
UPPS Sensation Seeking	7.29	3.33	7.42	3.53

UPPS lack of Perseverance	2.66	2.53	3.65	2.86
Negative Affectivity variables:				
BAI	31.19	8.95	29.48	8.54
BDI-II	10.82	9.37	12.83	11.34
PANAS Negative Affectivity	20.99	7.22	24.49	8.11
Positive Affectivity variables:				
PANAS Positive Affectivity	32.31	7.49	30.19	8.77
Reward and Punishment Sensitivity variables:				
BISBAS Behavioural Inhibition System	21.07	3.34	19.23	2.38
BISBAS Behavioural Activation System	39.34	4.53	36.92	3.69
TPQ Total Novelty Seeking	17.13	5.60	19.26	5.44
TPQ Total Harm Avoidance	14.83	7.01	16.55	7.60
TPQ Total Reward Dependence	18.73	4.50	19.16	4.00
Personality Disorder variables:				
PDQ-4 Paranoid	2.49	1.74	3.48	1.98
PDQ-4 Schizoid	1.28	1.28	1.83	1.58
PDQ-4 Schizotypal	2.00	1.74	2.79	2.22
PDQ-4 Histrionic	2.49	1.70	3.06	1.84
PDQ-4 Narcissistic	2.63	1.84	3.27	2.08
PDQ-4 Borderline	2.99	2.11	3.89	2.44
PDQ-4 Antisocial	1.43	1.55	2.18	1.97
PDQ-4 Avoidant	2.57	1.98	3.33	2.22
PDQ-4 Dependent	1.54	1.65	2.31	2.24
PDQ-4 Obsessive-compulsive	3.37	1.61	3.84	1.55
MCMI Schizoid	39.02	25.56	44.83	25.59
MCMI Avoidant	38.09	30.25	45.56	30.43
MCMI Dependent	43.46	28.27	48.07	28.42
MCMI Histrionic	67.31	23.25	58.15	25.86
MCMI Narcissistic	69.19	19.83	62.51	19.86
MCMI Antisocial	51.09	22.32	57.36	22.32
MCMI Compulsive	53.88	19.36	43.79	19.69
MCMI Schizotypal	37.71	28.02	47.27	29.28
MCMI Borderline	36.74	27.94	47.83	29.18
MCMI Paranoid	45.21	27.61	53.92	28.17
Problem Gambling Severity variables:				
PGOUT	.14	.29	N/A	N/A
PGSI	.83	2.30	6.87	7.07

An examination of the assumptions of normality for both samples revealed that none of the scored scales were significantly skewed. A visual inspection of the variables in the *student* sample using histograms indicated that the scales were relatively normally distributed. Statistically, the skewness for all scales fell between –0.8 and 1.4 which can

be considered adequate considering the sample size (Tabachnick & Fidell, 2001). In the *referred* sample, the variables were also visually inspected and found to be relatively normally distributed. All scored measures were assessed for univariate outliers; these are defined as scores greater than 3.29 SDs from the mean score (Tabachnick & Fidell, 2001). No outliers were discovered and the variables met all normality assumptions. Scatterplots among pairs of variables were examined to ensure linearity among the variables. Lastly, distance and other influence statistics were calculated and examined for each variable to check for multivariate normality (Tabachnick & Fidell, 2001). While it was originally proposed to use the CAARS B (Hyperactivity and Restlesness scale), C (Impulsivity/ Emotional Lability scale) and F (DSM-IV Hyperactive-Impulsive Symptoms scale), there was considerable multicollinearity between these three scales (with correlations ranging from .60 to .80) as well as evidence of singularity. Therefore, only the CAARS F (the DSM-IV Hyperactive-Impulsive Symptoms scale) will be included in further analyses. See appendix A for tables 4-7 containing the results of correlational analyses among all of the variables.

Data Reduction

Given that many of the questionnaires administered in this battery are purported to measure similar or overlapping constructs, a data reduction technique was used to identify the underlying core constructs and address potential issues of multicollinearity.

To create a data reduction model of the temperament variables, the measures pertaining to impulsivity, sensation seeking and affectivity were reduced using Principal Components Analysis (PCA) in both the *student* and the *referred* samples. PCA is often used as a data reduction technique to identify a small number of components that explain

as much of the variance as possible in a much larger number of manifest variables. PCA has been described as the solution of choice for researchers primarily interested in reducing a large number of variables down to a smaller number of components (Tabachnick & Fidell, 2001). A Varimax rotation was selected in order to maximize the variance of component loadings within components and identify uncorrelated variables (Tabachnick & Fidell, 2001). While the main purpose of this analysis is data reduction, the components will be rotated in order to allow for interpretability of the components and identify which scales are accounting for the most variance in later regression analyses. Orthogonal (Varimax) rotation was deemed most desirable because orthogonality in the predictors would most sharply focus the nature of the predictors. It is likely however, that the underlying structure of these variables may be correlated and therefore an orthogonal rotation may not best represent to true underlying structure of these constructs. To test this, Promax oblique and Crawford-Ferguson Varimax Orthogonal and Oblique techniques were used to gauge whether correlated components might improve the simple structure and interpretability of the loadings. The results of these analyses, as presented in appendix B, showed that using correlated dimensions failed to provide a more interpretable structure compared to the orthogonal Varimax loadings. The Promax oblique rotation did however identify moderate correlations among the personality disorder components (see Tables 40 and 41 for correlations). These loadings had slightly simpler structure than the orthogonal Varimax rotations as well. It was determined, however, that in order to maintain a level playing field between the temperament variables and the personality disorder variables, both would be reduced using an orthogonal rotation. Otherwise, if the personality disorder variables were

reduced using an oblique rotation, some of the shared variance between the personality disorders would overlap between the components and provide them with less predictive power compared to the temperament variables. Therefore, an orthogonal rotation was maintained for both sets of the variables in this study.

The number of components to be utilized as the predictor variables was selected using both parallel analysis (Horn, 1965) and the Minimum Average Partial test (MAP; Velicier, 1976). Both of these analyses were completed in SPSS using code provided in O'Connor (2000). Both parallel analysis and the MAP test suggested a four component solution (see appendix B for elaboration of results). Initially, the scales included in the model were the BAI, BDI-II, BIS and BAS, the three Barratt Impulsivity scales, the CAARS F scale, the two GRAPES scales, the two I7 scales, the two PANAS scales, the three TPQ scales, and the four UPPS scales.

In the *student* sample, the communality score for the CAARS F scale was .168 indicating that the factor solution accounted for very little variance in this scale and it was therefore excluded from the data reduction model for this sample.

The component loadings were evaluated to determine if the variables loaded as would be predicted by previous research. Findings indicated that solution loadings and cross-loadings were indeed similar to what was predicted.

Table 8

Varimax Rotated Component Matrix for the Student Sample

	Component			
	1	2	3	4
I7 -IMP	**.805**	.156	.117	.114
BRT -IM	**.799**	.185	.090	.115

UPPS -PM	**.777**	-.153	.136	-.073
TPQ -NS	**.773**	-.073	.317	.064
BRT -IC	**.728**	.215	-.096	-.069
BRT -INP	**.722**	-.063	.177	-.172
UPPS -PV	**.631**	.159	-.127	-.385
UPPS -UR	**.623**	.459	-.086	.162
BAI	.114	**.795**	.004	-.044
PANAS -NA	.108	**.791**	-.076	-.090
BDI-II	.201	**.778**	-.054	-.264
GRAPES -PE	-.054	**.539**	-.273	.141
UPPS -SS	.218	-.031	**.871**	.057
I7 -VENT	.184	-.065	**.857**	-.009
TPQ -HA	.004	.507	**-.609**	-.328
GRAPES -RE	-.116	-.245	**.542**	.481
BISBAS -BIS	-.058	.494	**-.539**	.308
TPQ -RD	-.108	.061	-.247	**.651**
PANAS -PA	-.064	-.367	.202	**.646**
BISBAS -BAS	.337	.092	.274	**.588**
Eigenvalue	5.15	4.43	1.82	1.34
% Variance	25.76	22.16	9.08	6.72

Note. The full scale names are BAI – Beck Anxiety Inventory; BDI- Beck Depression Inventory –II; BISBAS – Behavioral Inhibition System/Behavioral Activation System Scales (subscales: BIS – Behavioral Inhibition Scale and BAS – Behavioral Activation scale); BRT-11 – Barratt Impulsiveness Scale –11 (subscales: INP – Non-Planning, IC – Cognitive, and IM – Motoric); CAARS – Conners' Adult ADHD Rating scale (subscale F: Hyperactive-Impulsive scale); GRAPES – Generalized Reward and Punishment Expectancy Scale (subscales: PE – Punishment Expectancy and RE – Reward Expectancy); I7 – Impulsiveness Questionnaire 7 (subscales: IMP – Impulsivity and VENT – Venturesomeness, UPPS – Urgency, Premediation, Perseverance, and Sensation Seeking Impulsive Behaviour Scale (subscales: PM – lack of Premeditation, UR - Urgency, PV – lack of Perseverance, and SS – Sensation Seeking); PANAS – Positive and Negative Affective Schedule (subscales: NA – Negative Affectivity and PA – Positive Affectivity); TPQ – Tridimensional Personality Questionnaire (subscales: NS – Novelty-Seeking, HA – Harm Avoidance, and RD – Reward Dependence);

The first component contains all of the purported impulsivity measures in the dataset. The second component contains loadings for scales related to negative

affectivity, including the GRAPES scale of Punishment Expectancy. The third component contains the sensation seeking scales, as measured by the UPPS Sensation Seeking scale and the I7 Venturesomeness scale, the GRAPES Reward Expectancy scale, as well as negative loadings for the TPQ Harm Avoidance scale, and the Behavioural Inhibition Scale from the BISBAS. The last scale seems to relate to positive affectivity with high loadings from the PANAS Positive Affectivity scale, the BISBAS Behavioural Activation Scale and the TPQ Reward Dependency scale. In the *referred* sample, a PCA of the data obtained similar results to the *student* data apart from the loadings for three scales. The number of components to be utilized as the predicted variables were again selected using both parallel analysis (Horn, 1965) and the Minimum Average Partial test (MAP; Velicier, 1976). Both parallel analysis and the MAP test suggested a four-component solution (see appendix B for elaboration of results). In this sample, the CAARS F scale had a high communality value (.701) (unlike the student sample) and was included in the final model. This is likely due to the fact that a number of participants in the *referred* sample reported higher rates of ADHD symptoms while this was not the case in the *student* sample (see Table 3 for descriptives). The TPQ Reward Dependence variable had a low communality (.118) and was therefore excluded from the analysis.

Table 9

Varimax Rotated Component Matrix for the Referred Sample

	Component			
	1	2	3	4
BRT -IC	**.806**	-.008	.107	-.119
I7 -IMP	**.775**	.304	.124	.143
BRT -IM	**.773**	.193	.363	.073

UPPS -PM	**.719**	-.251	-.186	.342
TPQ -NS	**.718**	.059	.045	.509
UPPS -PV	**.674**	.017	-.393	-.026
CAARS_F	**.653**	.260	.438	-.115
UPPS -UR	**.594**	.466	-.191	.013
BDI-II	.197	**.820**	-.132	-.011
PANAS -NA	.032	**.813**	-.089	.053
BAI	.084	**.790**	-.026	.147
GRAPES -PE	.083	**.652**	.072	-.231
BISBAS -BIS	.039	**.643**	-.100	-.091
TPQ -HA	.053	**.570**	-.542	-.313
GRAPES -RE	-.019	-.142	**.816**	.120
PANAS -PA	.070	-.379	**.724**	.029
BISBAS -BAS	.222	.289	**.584**	.359
I7 -VENT	-.076	-.142	.446	**.794**
UPPS -SS	.005	-.182	.491	**.756**
BRT -INP	.452	.088	-.206	**.668**
Eigenvalue	5.44	4.52	2.24	1.49
% Variance	27.18	22.59	11.19	7.45

Note. The full scale names are BAI – Beck Anxiety Inventory; BDI- Beck Depression Inventory –II; BISBAS – Behavioral Inhibition System/Behavioral Activation System Scales (subscales: BIS – Behavioral Inhibition Scale and BAS – Behavioral Activation scale); BRT-11 – Barratt Impulsiveness Scale –11 (subscales: INP – Non-Planning, IC – Cognitive, and IM – Motoric); CAARS – Conners' Adult ADHD Rating scale (subscale F: Hyperactive-Impulsive scale); GRAPES – Generalized Reward and Punishment Expectancy Scale (subscales: PE – Punishment Expectancy and RE – Reward Expectancy); I7 – Impulsiveness Questionnaire 7 (subscales: IMP – Impulsivity and VENT – Venturesomeness, UPPS – Urgency, Premediation, Perseverance, and Sensation Seeking Impulsive Behaviour Scale (subscales: PM – lack of Premeditation, UR - Urgency, PV – lack of Perseverance, and SS – Sensation Seeking); PANAS – Positive and Negative Affective Schedule (subscales: NA – Negative Affectivity and PA – Positive Affectivity); TPQ – Tridimensional Personality Questionnaire (subscales: NS – Novelty-Seeking, HA – Harm Avoidance, and RD – Reward Dependence);

In the *referred* sample, the first component again contains all of the impulsivity measures in the dataset except for Barratt Non-Planning scale (BRT-INP). The second component contains loadings for scales related to negative affectivity and included the

GRAPES Punishment Expectancy scale. This component also contains high loadings for TPQ Harm Avoidance (which also has a high negative loading on the third component) and the Behavioural Inhibition System (BIS) Scale. The third component contains the positive affectivity scales with high loadings from the PANAS Positive Affectivity scale and the Behavioural Activation System (BAS) scale from the BISBAS and the GRAPES Reward Expectancy scale. The fourth component contains the sensation seeking scales, as measured by the UPPS Sensation Seeking scale and the I7 Venturesomeness scale. The BISBAS BIS scale and the TPQ Harm Avoidance scale seem to relate more to the negative affectivity construct in this sample (as opposed to having a negative loading on the sensation seeking scale as in the student sample).

Again, correlations between the student and referred samples were obtained to determine how similar the loading patterns were. The component loadings for the two samples were found to be congruent (see Table 10).

Table 10

Correlations between the temperament component loadings scores derived from the referred and student samples (n=19)

	Student Sample			
Referred Sample	1	2	3	4
1	.938**	-.184	-.128	-.244
2	-.275	.953**	-.640**	-.271
3	-.264	-.559*	.695**	.790**
4	.263	-.524*	.842**	.052

Note. These correlation analyses were completed using the scores from the rotated component matrix. There were 20 measures total in each sample but only 19 of the scales were similar across both samples due to the low communality score for the CAARS –F in the student sample and the low communality score for the TPQ Reward Dependence in the referred sample which were not included in their respective PCA.
*$p < .05$. **$p < .01$.

To create a data reduction model of the personality disorder measures, the ten personality disorder scores from the two inventories were also reduced into a smaller number of component factors using PCA. Accordingly, the scores on the 10 personality disorder scales for each participant were subjected to PCA with Varimax rotation for both the MCMI-III and the PDQ-4 measures combined. The number of components to be utilized as the predicted variables was selected using both parallel analysis (Horn, 1965) and the Minimum Average Partial test (MAP; Velicier, 1976). Both of these analyses were completed in SPSS using code provided in O'Connor (2000). For the student sample, both parallel analysis and the MAP test suggested a four-component solution (see appendix B for elaboration of results). The component loadings were evaluated to determine whether similar personality disorder scales from these two tests loaded onto the same components and if the loadings made sense theoretically.

Table 11

Varimax Rotated Component Matrix for the Student Sample

	Component			
	1	2	3	4
MCMI Schizoid	**.818**	.093	.212	.208
MCMI Histrionic	**-.789**	-.001	-.048	-.408
PDQ-4 Schizoid	**.707**	.175	.127	.021
MCMI Avoidant	**.663**	.138	.063	.601
MCMI Schizotypal	**.613**	.276	.288	.280
PDQ-4 Schizotypal	**.545**	.545	.161	.001
MCMI Paranoid	**.487**	.462	.266	.211
PDQ-4 Narcissistic	.184	**.762**	.237	-.074
PDQ-4 Histrionic	-.189	**.665**	.367	.128

PDQ-4 Paranoid	.328	**.640**	.266	.130
PDQ-4 Obsessive-Compulsive	.249	**.580**	-.034	.154
MCMI Compulsive	-.124	-.011	**-.875**	-.127
MCMI Antisocial	.114	.161	**.837**	-.034
PDQ-4 Antisocial	.205	.328	**.702**	-.178
MCMI Borderline	.352	.335	**.637**	.356
PDQ-4 Borderline	.178	.441	**.595**	.299
MCMI Narcissistic	-.217	.266	.083	**-.760**
MCMI Dependent	.198	.234	.260	**.740**
PDQ-4 Avoidant	.289	.320	-.049	**.687**
PDQ-4 Dependent	.010	.556	.202	**.587**
Eigenvalue	8.01	2.69	1.44	1.35
% Variance	40.04	13.43	7.18	6.73

The solution was similar to prior research using these same measures (Carroll, unpublished findings). Further, the identified components correspond to those found in past literature (i.e., Blackburn, Donelly, Logan & Renwick, 2004; Hyler, & Lyons, 1988) identifying the three main DSM Clusters. The first component is comprised of all of the personality disorders scales that have asocial or interpersonal avoidance characteristics. Many of these scales stem from Cluster A, the Odd/Eccentric personality disorders. Additionally, there was a strong loading for MCMI Avoidant and a strong negative weighting of MCMI Histrionic on this first component. The second component contains part of the Cluster B scales, the more dramatic/erratic of these scales. It also includes a fairly strong loading for PDQ-4 Paranoid, perhaps reflecting the overdeveloped sense of entitlement shared by the other scales on this component. These are the personality disorders that are often considered by psychoanalytic writers to comprise the broader construct of narcissism (Bursten, 1973; Kernberg, 1975). The third component contains

the more impulsive Cluster B personality disorders. It is noteworthy that both of the Borderline and both of the Antisocial PD scales load on this component, suggesting a strong convergence between these two personality disorders in the *student* sample. Lastly, the fourth component contains scales for Cluster C, the Anxious/Fearful Cluster as well as a negative loading for MCMI Narcissistic, a personality disorder described as exuding high self-confidence and lack of anxiety. These are also scales related to anxious attachment styles (Horowitz, 2004) (see Table 11 for loadings). The only personality disorder that did not load according to its DSM Cluster classification is the Obsessive-Compulsive Scale for both the MCMI and PDQ-4. The PDQ-4 Obsessive-Compulsive scale loaded with other personality disorders with obsessive features while the MCMI Compulsive scale had a strong negative loading with the more impulsive personality disorders.

For the *referred* sample, the personality disorders were also reduced using PCA with a Varimax rotation. Using parallel analysis (Horn, 1965), a two-component solution was suggested whereas, using the MAP test (Velicer, 1976) a four component solution was suggested (see Appendix B for an elaboration of these results). Since the analysis derived from the student sample suggested a four-component solution, this too was selected for the referred sample. The four component solution was similar to the *student* data although similar factors accounted for differing amounts of variance (i.e., loaded in a different order). Using a Procrustes Rotation, factor invariance across gender and across both samples was also determined for the personality disorder scales (see appendix B).

Table 12

Varimax Rotated Component Matrix for Referred Sample

	Component

	1	2	3	4
PDQ-4 Histrionic	**.798**	.228	.131	-.088
PDQ-4 Obsessive-Compulsive	**.707**	-.045	.001	.305
PDQ-4 Schizotypal	**.627**	.273	.179	.482
PDQ-4 Narcissistic	**.625**	.473	.117	.188
PDQ-4 Paranoid	**.611**	.331	.147	.324
MCMI Paranoid	**.552**	.293	.239	.471
PDQ-4 Antisocial	.054	**.833**	.088	.175
MCMI Antisocial	.157	**.826**	-.099	.172
MCMI Compulsive	-.203	**-.820**	-.150	-.171
MCMI Borderline	.423	**.686**	.300	.194
PDQ-4 Borderline	.506	**.593**	.441	.168
MCMI Narcissistic	.200	.009	**-.853**	-.171
PDQ-4 Avoidant	.342	.058	**.745**	.272
MCMI Dependent	.475	.196	**.696**	.113
MCMI Avoidant	.190	.084	**.673**	.550
PDQ-4 Dependent	.529	.289	**.625**	.083
MCMI Schizoid	.171	.220	.176	**.837**
PDQ-4 Schizoid	.255	.225	.119	**.731**
MCMI Histrionic	.032	-.216	-.528	**-.721**
MCMI Schizotypal	.398	.168	.392	**.507**
Eigenvalue	9.54	2.31	1.51	1.27
% Variance	47.68	11.56	7.54	6.33

In the case of the *referred* sample, the first component is a mix between some of the Cluster A scales (the Odd/Eccentric Cluster) as well as the more dramatic personality disorders from Cluster B perhaps again reflecting the overdeveloped sense of entitlement shared by many of the scales loading onto this component (Bursten, 1973; Kernberg, 1975). The PDQ-4 Obsessive-Compulsive and Schizotypal scales also load onto this

component and may contribute an obsessive quality to this component. The second component is very similar to the third component in the *student* sample, containing both of the Borderline and both of the Antisocial scales and, again, a strong negative loading for MCMI Compulsive. The third component contains the Cluster C scales, also known as the Anxious/Fearful Cluster as well as a negative loading for MCMI Narcissistic (just as in the fourth component of the student data). The fourth component is comprised of loadings from the remaining Cluster A scales and a strong negative loading for MCMI Histrionic, likely due to the asocial aspect of these disorders (see Table 12 for loadings). Again, the personality disorder that did not load according to its DSM-IV cluster assignment was the PDQ-4 Obsessive-Compulsive scale and the MCMI Compulsive scale. Instead, the PDQ-4 Obsessive-Compulsive scale loaded along with the Paranoid Personality Disorder scales and the MCMI Compulsive Scale had a strong negative loading on the impulsive component in both samples.

Correlations were obtained between the component loading scores for the two samples to determine how similar the loading patterns were. The component loadings for the two samples were very congruent, with correlations ranging from .89 to .99 (see Table 13).

Table 13

Correlations between the personality disorder component scores from the referred and student samples (n = 20)

	Student Sample			
Referred Sample	1	2	3	4
1	.184	.886**	.323	.343
2	.294	.375	.963**	.140

3	.547*	.208	.174	.961**
4	.985**	.115	.205	.431

Note. These correlation analyses were completed using the scores from the rotated component matrix for the 20 scales in each sample.

*$p < .05$. **$p < .01$

Regression Analyses

A power analysis (using GPOWER; Faul, & Erdfelder, 1992) was conducted for each of the regression analyses to ascertain the observed probability of detecting effects of different sizes given the two samples used in this study. Conventions established by Cohen (1992) regarding what constitutes a small, medium or large effect size were utilized. For the student sample, the sample was deemed large enough to detect a medium effect size ($f^2 = 0.15$) using both 4 and 9 predictors (Power = 1.00, Lambda = 73.05) although, for a small effect size ($f^2 = 0.02$), the sample size is barely adequate for 4 predictors (Power = 0.70, Lambda = 9.74) but insufficient using 9 predictors (Power = 0.54, Lambda = 9.74). For the referred sample only 80 of the participants completed all of the temperament variables. Using a sample size of 80, there was barely adequate power to detect a medium size effect using 4 predictors (Power = 0.77, Lambda = 12.00) but not a small effect (Power = 0.14, Lambda = 1.6). Using 9 predictors, the power was insufficient for a medium effect size (Power = 0.60, Lambda = 12.00) as well as for a small effect size (Power = 0.10, Lambda = 1.6).

Testing the primary hypothesis

The primary hypothesis posited in this study pertains to the interrelation among the temperament and personality disorder variables as predictors of problem gambling severity. It was hypothesized that, while the temperament variables will likely account for

much of the relationship between personality psychopathology and problem gambling, the personality disorders will contribute unique variance to the model. The following set of analyses was selected to test this hypothesis.

In the *student* data the temperament components were entered first into the hierarchical regression analysis, followed by the personality disorder components in the second step.

Using the PGOUT as the dependent variable in the *student* data, the first step (consisting of the temperament components alone) returned an R^2 of .04 ($F(4, 481) = 5.54, p < .001$), while the second step returned a significant R^2chg of .03 ($Fchg(4, 477) = 4.26, p = .002$). Thus, the personality disorder components accounted for 3% of the variance above and beyond the temperament variables (see Table 14). In the second step of the hierarchical regression, when all of the measures were included, only the narcissistic ($\beta = .12, t = 2.33, p = .020$) and impulsive ($\beta = .27, t = 3.63, p < .001$) personality disorder components significantly contributed to the model.

Table 14

Hierarchical Regression Analysis of the Temperament and Personality Disorder Components on Problem Gambling (PGOUT) in the Student Sample

Variable	*Step 1*			*Step 2*		
	B	*SE B*	*ß*	*B*	*SE B*	*ß*
Independent variables:						
T1 – Impulsivity	.419	.125	.149**	-.121	.194	-.043
T2 – Negative Affectivity	.279	.125	.099*	0.102	.183	-.036
T3 – Sensation Seeking	.217	.125	.077	-.018	.164	-.006
T4 – Positive Affectivity	-.216	.125	-.077	-.106	.152	-.038
PD1 – Cluster A Asocial				.220	.150	.078

PD2 – Cluster A/B Narcissistic	.344	.148	.123*
PD3 – Cluster B Impulsive	.767	.211	.273**
PD4 – Cluster C Anxious	.090	.179	.032

*$p < .05$. **$p < .01$.

The next step taken was to determine if the temperament variables account for any significant unique variance above and beyond the personality disorder variables by reversing the order of entry into the steps of the hierarchical regression equation. The first step consisting of the personality disorder components alone returned an R^2 of .08 ($F(4, 481) = 9.69, p < .001$), while the second step returned a significant R^2chg of .002 ($Fchg(4, 477) = .318, p = .866$). Thus, the temperament components did not account for any significant variance above and beyond the temperament variables (see Table 15).

Table 15

Hierarchical Regression findings by reversing the entry of the variables into the regression equation using the PGOUT in the student sample

Initial Regression Step 1: Temperament variables Step 2: Personality Disorder variables					Reverse Entry Regression Step 1: Personality Disorder variables Step 2: Temperament variables				
Model	R^2	Change Statistics			Model	R^2	Change Statistics		
		R^2 Change	F Change	Sig. F Change			R^2 Change	F Change	Sig. F Change
1	.044	.044	5.54	.000**	1	.075	.075	9.69	.000**
2	.077	.033	4.26	.002**	2	.077	.002	.32	.866

*$p < .05$. **$p < .01$.

The same analyses were repeated using the PGSI as the outcome variable in the *student* data. For the initial regression, the first step consisting of the temperament

components alone returned an R^2 of .04 ($F(4, 481) = 4.93, p = .001$), while the second step, consisting of the personality disorder components returned a significant R^2chg of .03 ($Fchg(4, 477) = 3.82, p = .005$). Thus, the personality disorder components accounted for 3% of the variance above and beyond the temperament variables (see Table 16). In the second step of the hierarchical regression, when all of the measures were included, only the impulsive personality disorder component was a significant predictor ($\beta = .25, t = 3.35, p = .001$) while the narcissistic personality disorder component approached significance ($\beta = .10, t = 1.94, p = .053$).

Table 16

Hierarchical Regression Analysis of the Temperament and Personality Disorder Components on Problem Gambling (PGSI) in the Student Sample (n = 486)

Variable	*Step 1*			*Step 2*		
	B	*SE B*	*ß*	*B*	*SE B*	*ß*
Independent variables:						
T1 – Impulsivity	.346	.103	.150**	-.051	.160	-.022
T2 – Negative Affectivity	.174	.103	.076	-.065	.151	-.028
T3 – Sensation Seeking	.214	.103	.093*	-.019	.135	.008
T4 – Positive Affectivity	-.116	.103	-.050	-.036	.125	-.016
PD1 – Cluster A Asocial				.189	.124	.082
PD2 – Cluster A/B Narcissistic				.236	.122	.103
PD3 – Cluster B Impulsive				.583	.174	.253*
PD4 – Cluster C Anxious				-.038	.148	-.017

Note. T – Temperament and PD – Personality Disorder.
*$p < .05$. **$p < .01$.

A reverse-entry hierarchical regression was performed using the same variables. The first step consisting of the personality disorder components alone returned an R^2 of

.07 ($F(4, 481) = 8.239, p < .001$), while the second step consisting of the temperament variables returned a non-significant R^2chg of .001 ($Fchg(4, 477) = .102, p = .982$). Once again, the temperament components did not account for any significant variance above and beyond the temperament variables (see Table 17).

Table 17

Hierarchical Regression findings by reversing the entry of the variables into the regression equation using the PGSI in the student sample

Initial Regression Step 1: Temperament variables Step 2: Personality Disorder variables					Reverse Entry Regression Step 1: Personality Disorder variables Step 2: Temperament variables				
Model	R^2	Change Statistics			Model	R^2	Change Statistics		
		R^2 Change	F Change	Sig. F Change			R^2 Change	F Change	Sig. F Change
1	.039	.039	4.93	.001**	1	.068	.068	8.23	.000**
2	.069	.030	3.82	.005**	2	.069	.001	.10	.982

*$p < .05$. **$p < .01$.

The results of the above analyses indicate that, in the student sample using both the PGOUT and the PGSI, there was no residual incremental variance uniquely predicted by the temperament components when they were entered in the second block. This implies that the personality disorder dimensions completely account for the relationship between temperament and problem gambling.

In the referred sample, the same hierarchical analyses was performed. The first step (consisting of the temperament components alone) returned an R^2 of .13 ($F(4, 75) = 2.83, p = .030$), while the second step returned a non-significant R^2chg of .07 ($Fchg(4, 71) = 1.62, p = .178$). Thus, the personality disorder components did not account for

variance above and beyond the temperament variables (see Table 18). In the second step of the hierarchical regression, when all of the measures were included, none of the components were significant. The effect size was medium (f^2 = .25) for the overall model, once all of the predictors were entered into the equation, however, with a sample size of 80, the power was only .62 to detect a significant medium size effect.

Table 18

Hierarchical Regression Analysis of the Temperament and Personality Disorder Components on Problem Gambling (PGSI) in Referred Sample

Variable	*Step 1*			*Step 2*		
	B	*SE B*	*ß*	*B*	*SE B*	*ß*
Independent variables:						
T1 – Impulsivity	1.287	.761	.277	1.807	1.160	.256
T2 – Negative Affectivity	.085	.761	.012*	2.428	1.269	.343
T3 – Positive Affectivity	.085	.761	.012	.154	.898	.022
T4 – Sensation Seeking	1.028	.761	.145	1.218	1.033	.172
PD1 – Cluster A/B Narcissistic				-.968	1.089	-.141
PD2 – Cluster B Impulsive				-.581	1.348	-.082
PD3 – Cluster C Anxious				-.565	1.048	-.079
PD4 – Cluster A Asocial				1.548	.830	.222

Note. T – Temperament and PD – Personality Disorder.
*$p < .05$. **$p < .01$.

Yet again, a reverse-entry hierarchical regression was performed using the same variables. The first step consisting of the personality disorder components alone returned an R^2 of .15 ($F(4, 75) = 3.21, p = .017$), while the second step consisting of the temperament variables returned a non-significant R^2chg of .06 ($Fchg(4, 71) = 1.28, p = .284$). While the R^2chg statistic indicated a fairly substantial amount of incremental variance, this statistic was not significant and thus not reliable (see Table 19). As stated

above, in the referred sample there was insufficient power to identify even a moderate effect size using 8 predictor variables.

Table 19

Hierarchical Regression findings by reversing the entry of the variables into the regression equation using the PGSI in the student sample

Initial Regression Step 1: Temperament variables Step 2: Personality Disorder variables					Reverse Entry Regression Step 1: Personality Disorder variables Step 2: Temperament variables				
Model	R^2	Change Statistics			Model	R^2	Change Statistics		
		R^2 Change	F Change	Sig. F Change			R^2 Change	F Change	Sig. F Change
1	.131	.131	2.83	.030*	1	.146	.146	3.21	.017*
2	.204	.073	1.62	.178	2	.204	.058	1.28	.284

*$p < .05$. **$p < .01$.

Since the sample size for the referred sample is too small to allow for sufficient power to detect a small or medium effect size, a backward entry regression analysis was performed to determine incremental predictive variance of the remaining independent variables once non-contributory variables were removed ($F < .10$). In the final model, only four variables were retained, the asocial personality disorder component, the impulsive temperament component, the negative affectivity temperament component and the sensation seeking temperament component. Of those four, only the asocial personality disorder component was a significant predictor ($\beta = .26$, $t = 2.41$, $p = .018$).

Testing the secondary hypothesis

The secondary hypothesis was then tested using moderated regression analyses to include the effects of gender as a possible moderating variable. It was hypothesized that

gender will moderate the relation between impulsivity and negative affectivity with problem gambling. Given the results of previous research, impulsivity was expected to be a stronger predictor of problem gambling for males and negative affectivity a stronger predictor for females. If gender is identified as a significant moderator, this may affect the results of the previous analyses. Therefore, controlling for gender may provide additional predictive strength for the temperament variables when testing the interrelation between the temperament variables and the personality disorder variables as predictors of problem gambling severity.

The first step in testing this hypothesis is to determine if, in fact, gender moderates the relationship between the temperament variables and problem gambling severity. Given that the predictor variables are all standardized, there was no need to centre them. Each predictor was then multiplied with the moderator variable (gender) to form interaction terms. To test the hypothesis that the temperament variables may be moderated by gender, hierarchical regression analyses were performed. This model included the component scores derived from the temperament components and gender followed by the cross product terms of each of these variables with gender in the second step.

In the *student* sample, using the PGOUT as the dependent variable, the main effects portion of the model accounted for 6.9% of the variance, $F(5, 480) = 7.08, p < .001$. The components labelled impulsivity ($B = .55$ $t = 3.53, p < .001$) and negative affectivity ($B = .32$ $t = 2.11, p = .035$) again significantly predicting problem gambling along with gender ($B = .59$ $t = 3.37, p = .001$)[1] once all of the predictors, including the

interaction terms, were entered into the model. The interaction model did not contribute significantly above and beyond the main effect model and none of the interaction terms were significant predictors therefore gender did not moderate the temperament variables in this sample (see Table 20).

Table 20

Hierarchical Regression Analysis of the Temperament Variables moderated by gender on Problem Gambling (PGOUT) for the student sample (n = 486)

Variable	*Step 1*			*Step 2*		
	B	*SE*	*ß*	*B*	*SE*	*ß*
Independent variables:						
T1 – Impulsivity	.445	.124	.159**	.545	.154	.194**
T2 – Negative Affectivity	.321	.124	.114*	.322	.152	.115*
T3 – Sensation Seeking	.057	.131	.020	.010	.158	.004
T4 – Positive Affectivity	-.141	.125	-.050	-.173	.139	-.062
Gender	.559	.157	.170**	.591	.175	.180**
Interaction variables:						
Impulsivity*Gender				.169	.154	.060
Negative Affectivity*Gender				-.004	.152	.001
Sensation Seeking*Gender				-.077	.158	-.026
Positive Affectivity*Gender				-.088	.139	-.031

Note: R^2 Step 1 = .069, $F(5, 480) = 7.08$, $p < .001$. ΔR^2 Step 2 = .004, $Fchg(4, 476) = .47$, p = ns.
T – Temperament and PD – Personality Disorder.
*$p < .05$. **$p < .01$.

[1] In equations that include interaction terms, the unstandardized (*B*) regression coefficient should be reported instead of the standardized (β) regression coefficient because, due to the interaction terms, the β coefficients for the interaction terms are not properly standardized and not interpretable (Aiken & West, 1991).

Repeating the same analysis using the PGSI as the dependent variable, the main effects portion of the model accounted for 5.8% of the variance, $F(5, 480) = 5.87, p < .001$ with the components labelled impulsivity ($B = .36$ $t = 3.56, p < .001$) and negative affectivity ($B = .20$ $t = 1.99, p = .047$) significantly predicting problem gambling along with gender ($B = .40$ $t = 3.05, p = .002$). This finding differs from the previous analysis identifying impulsivity and sensation seeking as the two temperament predictors of problem gambling severity as measured by the PGSI (see Table 16). The inclusion of gender allowed for a clearer allocation of variance in the model, rendering sensation-seeking non-significant and allowing negative affectivity to become a significant predictor. Both of these variables have clearly demonstrated gender differences with men often having higher levels of sensation-seeking and women higher levels of negative affectivity. However, once all of the predictors, including the interaction terms, were entered into the model, no interaction effects between gender and any of the temperament variables were identified and the interaction model did not contribute significantly above and beyond the main effect model. Also, negative affectivity was no longer a significant predictor ($B = .21$ $t = 1.69, p = .092$).

Table 21

Hierarchical Regression Analysis of the Temperament Variables moderated by gender on Problem Gambling (PGSI) for the student sample (n = 486)

Variable	*Step 1*			*Step 2*		
	B	*SE B*	*ß*	*B*	*SE B*	*ß*
Independent variables:						
T1 – Impulsivity	.364	.102	.158**	.437	.128	.190**
T2 – Negative Affectivity	.204	.103	.089*	.213	.126	.092

T3 – Sensation Seeking	.101	.109	.044	.048	.131	.021
T4 – Positive Affectivity	-.063	.104	-.027	-.049	.115	-.021
Gender	.395	.130	.146**	.450	.145	.166**
Interaction variables:						
Impulsivity*Gender				.119	.128	.052
Negative Affectivity*Gender				-.010	.126	.004
Sensation Seeking*Gender				-.090	.131	-.037
Positive Affectivity*Gender				-.025	.115	-.022

Note: R^2 Step 1 = .058, $F(5, 480) = 5.87$, $p < .001$. ΔR^2 Step 2 = .003, $Fchg(4, 476) = .33$, p = ns.
T – Temperament and PD – Personality Disorder.
*$p < .05$. **$p < .01$.

In the *referred* sample, the main effects portion of the model was significant, $F(5, 74) = 2.43$, $p = .043$, accounting for 14.1% of the variance in problem gambling severity. The test for an interaction was significant, $R^2chg = .14$, $Fchg(4, 70) = 3.34$, $p = .015$. In the second model, once the interaction variables were included and the variance was parcelled out to all possible predictor, there was a main effect for the negative affectivity component ($B = 2.52$ $t = 3.34$, $p = .001$) but no main effect for gender. Two of the interaction variables were also significant, with the interaction terms for the impulsivity-gender ($B = -1.77$ $t = -2.26$, $p = .027$) and positive affectivity-gender ($B = -1.80$ $t = -2.37$, $p = .021$) variables significantly predicting problem gambling (see Table 22).

Table 22

Hierarchical Regression Analysis of the Temperament Variables moderated by gender on Problem Gambling (PGSI) in Referred Sample (n = 80)

Variable	*Step 1*			*Step 2*		
	B	*SE B*	*ß*	*B*	*SE B*	*ß*
Independent variables:						

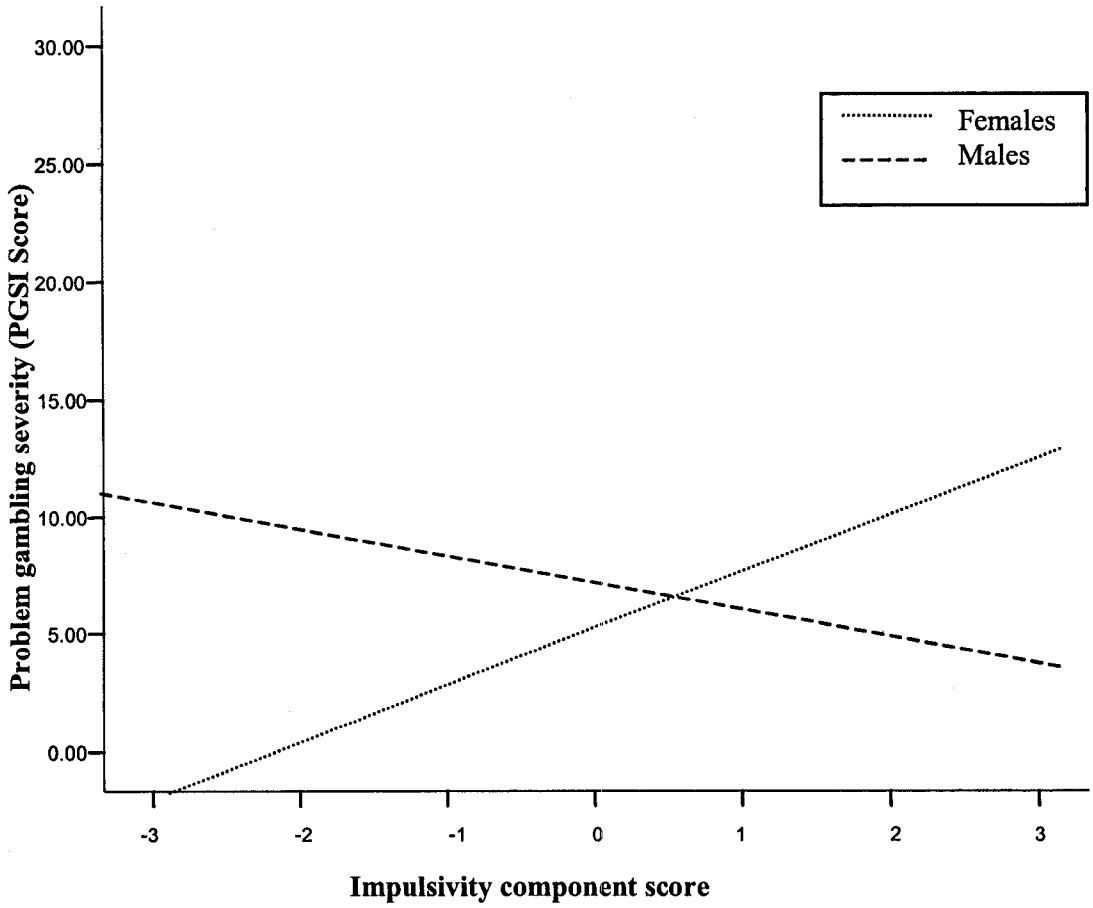
T1 – Impulsivity	1.18	.775	.167	.530	.780	.075
T2 – Negative Affectivity	2.02	.765	.286*	2.519	.755	.356**
T3 – Positive Affectivity	-.038	.773	-.005	.170	.759	.024
T4 – Sensation Seeking	.776	.810	.110	1.231	.8549	.174
Gender	.771	.844	.108	.743	.814	.104
Interaction variables:						
Impulsivity*Gender				-1.765	.780	-.247*
Negative Affectivity*Gender				-.151	.755	-.021
Positive Affectivity*Gender				-1.796	.759	-.251*
Sensation Seeking*Gender				1.204	.859	.161

Note: R^2 Step 1 = .141, $F(5, 74) = 2.43$, $p = .043$. ΔR^2 Step 2 = .138, $Fchg(4, 70) = 3.34$, $p = .015$. T – Temperament and PD – Personality Disorder.
$*p < .05$. $**p < .01$.

In order to interpret the interaction effects, the simple effects for each significant interaction variable were analysed and plotted by gender. First, the impulsivity component was examined and it was determined that this variable a) had a positive slope for the females but a negative slope for the males, and b) remained a significant predictor for the females in the sample ($B = 2.42$ $t = 2.56$, $p = .013$) but not the males ($B = -1.06$ $t = -.83$, $p = ns$) when all other covariates were controlled for in the equation (see Figure 1). This finding is opposite to what was hypothesized, indicating that impulsivity predicted increased problem gambling for females but not males.

Figure 1

Plotted effects for impulsivity component by gender on PGSI score with all other components controlled

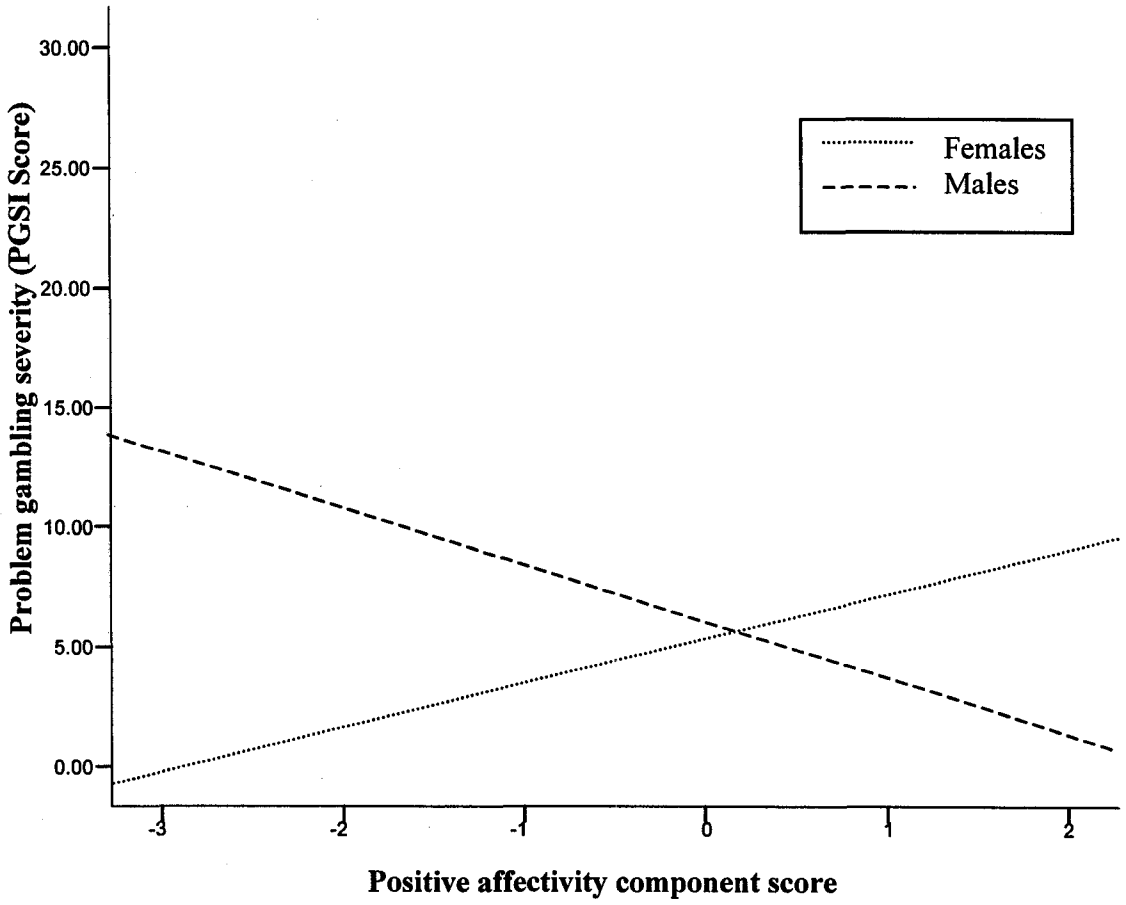


For the positive affectivity component, this variable was not a significant predictor for females (n = 58, $B = 1.82$ $t = 1.74$, $p = ns$) while for males, the variable approached significance (n = 39, $B = -2.10$ $t = -1.90$, $p = .061$) when all other covariates were controlled for in the equation (See Figure 2). Again, this finding is opposite to what would be expected given previous research. In this case, the more depressed a male is the more likely he is to gamble while the opposite appears true for females. It is important to note that that the power to detect a medium effect size was .25 and a large effect size was

.59 indicating that there was insufficient power to identify significant effects when tested by gender in this sample.

Figure 2

Plotted effects for positive affectivity component by gender on PGSI score with all other components controlled



Hierarchical Regression Analyses Including Gender

Since gender was identified as a significant predictor in the student sample and as a significant moderator in the referred sample, the last set of analyses was selected to determine if the personality disorder variables predict any variance above and beyond the

temperament variables once gender had been controlled. In the *student* data, gender was entered into the first step, the temperament components were entered into the second step, followed by the personality disorder components in the third step of the hierarchical regression analysis.

The first step, containing the gender variable, returned an R^2 of .03 ($F(1.\ 481) = 13.73, p < .001$). The second step, consisting of the temperament components, returned an R^2chg of .04, $Fchg(4, 480) = 5.30, p < .001$. The third step, containing the personality disorder variables, returned a significant R^2chg of .02, $Fchg(4, 476) = 3.01, p = .018$. Thus, the personality disorder components accounted for 2% of the variance above and beyond the temperament variables once gender had been controlled for (see Table 23). In the third step of the hierarchical regression, when all of the measures were included, gender remained a significant predictor ($\beta = .15, t = 2.78, p = .006$) and, only the narcissistic ($\beta = .11, t = 2.03, p = .043$) and impulsive ($\beta = .23, t = 3.05, p = .002$) personality disorder components significantly contributed to the model.

Table 23

Hierarchical Regression Analysis of Gender, Temperament and Personality Disorders on Problem Gambling (PGOUT) in the Student Sample

Variable	*B*	*SE B*	*ß*
Step 1:			
Gender	.546	.147	.166**
Step 2:			
Gender	.559	.157	.170**
T1 – Impulsivity	.445	.124	.159**
T2 – Negative Affectivity	.321	.124	.114*
T3 – Sensation Seeking	.057	.131	.020

T4 – Positive Affectivity	-.141	.125	-.050
Step 3:			
Gender	.475	.171	.145**
T1 – Impulsivity	-.032	.195	-.011
T2 – Negative Affectivity	.086	.194	.031
T3 – Sensation Seeking	-.167	.172	-.060
T4 – Positive Affectivity	-.133	.151	-.047
PD1 – Cluster A Asocial	.063	.160	.023
PD2 – Cluster A/B Narcissistic	.300	.147	.107*
PD3 – Cluster B Impulsive	.653	.214	.233**
PD4 – Cluster C Anxious	-.056	.185	-.020

Note. T – Temperament and PD – Personality Disorder.
*$p < .05$. **$p < .01$.

This analysis was repeated and the order of entry of the component variables was reversed. In each case, gender was entered into the first block to partial out its effects. The personality disorder components were entered into the second block and the temperament components were entered into the third block.

In the student sample, the personality disorder dimensions again completely accounted for the relationship between temperament and problem gambling, even after the effects of gender were taken into account. When the personality disorder components were entered in the second block (following gender) in the reverse entry regression, the R^2chg coefficient was significant for the second block (R^2chg of .06, $Fchg(4, 480) = 8.02$, $p < .001$) and there was no residual incremental variance to be predicted by the temperament variables in the third block.

Table 24

Regression findings by reversing the entry of the variables into the regression equation for the PGOUT dependent variable in the Student Sample

Initial Regression Step 1: Gender Step 2: Temperament variables Step 3: Personality Disorder variables					Reverse Order Regression Step 1: Gender Step 2: Personality Disorder variables Step 3: Temperament variables				
Model	R^2	Change Statistics			Model	R^2	Change Statistics		
		R^2 Change	F Change	Sig. F Change			R^2 Change	F Change	Sig. F Change
1	.028	.028	13.73	.000**	1	.028	.028	13.73	.000**
2	.069	.041	5.30	.000**	2	.088	.061	8.02	.000**
3	.092	.023	3.01	.018*	3	.092	.003	0.43	.791

*$p < .05$. **$p < .01$.

This analysis was repeated for the student sample using the PGSI as the dependent variable. The first step, containing the gender variable, returned an R^2 of .02 ($F(1, 481) = 10.99, p = .001$). The second step, consisting of the temperament components, returned an R^2chg of .04, $Fchg(4, 480) = 4.52, p = .001$. The third step, containing the personality disorder variables, returned a significant R^2chg of .02, $Fchg(4, 476) = 2.93, p = .020$. Thus, the personality disorder components again accounted for 2% of the variance above and beyond the temperament variables once gender had been controlled for (see Table 24). In the third step of the hierarchical regression, when all of the measures were included, gender remained a significant predictor ($\beta = .13, t = 2.40, p$

< .001) and, only the impulsive personality disorder component (β = .22, t = 2.84, p = .005) significantly contributed to the model.

Table 25

Hierarchical Regression Analysis of Gender, Temperament and Personality Disorders on Problem Gambling Severity (PGSI) in the Student Sample

Variable	*B*	*SE B*	*β*
Step 1:			
Gender	.402	.121	.149**
Step 2:			
Gender	.395	.130	.146**
T1 – Impulsivity	.364	.102	.158**
T2 – Negative Affectivity	.204	.103	.089*
T3 – Sensation Seeking	.101	.109	.044
T4 – Positive Affectivity	-.063	.104	-.027
Step 3:			
Gender	.340	.141	.126*
T1 – Impulsivity	.013	.161	.006
T2 – Negative Affectivity	.070	.160	.030
T3 – Sensation Seeking	-.126	.142	-.055
T4 – Positive Affectivity	-.056	.125	-.024
PD1 – Cluster A Asocial	.077	.132	.034
PD2 – Cluster A/B Narcissistic	.205	.122	.089
PD3 – Cluster B Impulsive	.502	.177	.218**
PD4 – Cluster C Anxious	-.143	.153	-.062

Note. T – Temperament and PD – Personality Disorder.
*p < .05. **p < .01.

This analysis was repeated and the order of entry of the component variables was reversed. In each case, gender was entered into the first block to partial out its effects. The personality disorder components were entered into the first block and the temperament components were entered into the second block

In the student sample, the personality disorder dimensions again completely accounted for the relationship between temperament and problem gambling, even after the effects of gender were taken into account. When the personality disorder components were entered in the second block (following gender) in the reverse entry regression, the R^2chg coefficient was significant in the second block for both dependent variables (R^2chg of .06, $Fchg(4, 480) = 7.31, p < .001$) and there was no residual incremental variance to be predicted by the temperament variables in the third block.

Table 26

Regression findings by reversing the entry of the variables into the regression equation using the PGSI as the dependent variable in the Student Sample

Initial Regression Step 1: Gender Step 2: Temperament variables Step 3: Personality Disorder variables					Reverse Order Regression Step 1: Gender Step 2: Personality Disorder variables Step 3: Temperament variables				
Model	R^2	Change Statistics			Model	R^2	Change Statistics		
		R^2 Change	F Change	Sig. F Change			R^2 Change	F Change	Sig. F Change
1	.022	.022	10.99	.001**	1	.022	.022	10.99	.001**
2	.058	.035	4.52	.001**	2	.078	.056	7.31	.000**

3	.080	.023	2.93	.020*	3	.080	.002	0.26	.905

*$p < .05$. **$p < .01$.

In the referred sample, the same hierarchical analysis was performed. The first step consisting of gender was not significant, $R^2 = .20$ ($F(1, 78) = 1.60$, $p = .210$, while the second step, consisting of the temperament components was significant with an R^2chg of .12, $Fchg(4, 74) = 2.60$, $p = .043$. The third step, consisting of the personality disorder components, was not significant with an R^2chg of .07 ($Fchg(4, 70) = 1.46$, $p = .223$). Thus, the personality disorder components did not account for variance above and beyond the temperament variables (see Table 25).

Table 27

Hierarchical Regression Analysis of Gender, Temperament and Personality Disorders on Problem Gambling (PGSI) in Referred Sample

Variable	*B*	*SE B*	*ß*
Step 1:			
Gender	1.016	.804	.142
Step 2:			
Gender	.771	.844	.108
T1 – Impulsivity	1.182	.770	.167
T2 – Negative Affectivity	2.024	.765	.286*
T3 – Positive Affectivity	-.038	.773	-.005
T4 – Sensation Seeking	.776	.810	.110
Step 3:			
Gender	.538	.998	.075
T1 – Impulsivity	1.844	1.167	.261
T2 – Negative Affectivity	2.552	1.297	.361
T3 – Positive Affectivity	-.075	.998	-.011

T4 – Sensation Seeking	1.118	1.055	.158
PD1 – Cluster A/B Narcissistic	-.837	1.121	-.122
PD2 – Cluster B Impulsive	-.797	1.413	-.112
PD3 – Cluster C Anxious	-.776	1.124	-.109
PD4 – Cluster A Asocial	1.430	.863	.205

Note. T – Temperament and PD – Personality Disorder.
$*p < .05$. $**p < .01$.

The regression analysis was again re-run but the order of entry was reversed. The temperament variables did not contribute a significant increase in predicted variance. The third block R^2chg was not significant in either case and thus neither the personality disorder components nor the temperament components contributed significant unique incremental variance, regardless of order of entry. It is likely that there was insufficient power to detect an effect using 9 predictors with such a small sample size.

Table 28

Regression findings by reversing the entry of the variables into the regression equation using the PGSI as the dependent variable in the referred sample

Initial Regression	Reverse Order Regression
Step 1: Gender	Step 1: Gender
Step 2: Temperament variables	Step 2: Personality Disorder variables
Step 3: Personality Disorder variables	Step 3: Temperament variables

Model	R^2	Change Statistics			Model	R^2	Change Statistics		
		R^2 Change	F Change	Sig. F Change			R^2 Change	F Change	Sig. F Change
1	.020	.020	1.60	.210	1	.020	.020	1.60	.210
2	.141	.121	2.60	.043*	2	.148	.128	2.79	.033*

3	. 207	.067	1.46	.223	3	.207	.059	1.30	.278

*$p < .05$. **$p < .01$.

Summary of Findings

The main hypothesis in this study posited that the personality disorder variables would contribute unique variance to the model. This hypothesis was tested using hierarchical regression analyses. The first, using the PGOUT as the dependent variable in the student sample found that once the personality disorder variables were entered into the second step, none of the temperament variables remained significant and both the narcissistic and impulsive personality disorder components were the sole predictors of problem gambling severity. A reverse-entry regression further determined that the temperament components did not account for any significant variance above and beyond the personality disorder components. Using the PGSI as the dependent variable, again in the student sample, results indicated that once the personality disorder variables were entered into the second step, none of the temperament variables remained significant and only the impulsive personality disorder component was the only significant predictor (the narcissistic component approached significance). A reverse-entry regression further determined that the temperament components did not account for any significant variance above and beyond the personality disorder components.

Lastly, the same hypothesis was tested in the referred sample using the PGSI as the dependent variable. In this sample, there was insufficient power to identify a small or medium effect size. While the R^2 change indicated a fairly substantial amount of incremental variance, it was not significant for the personality disorder components in the second step. A reverse-entry regression also failed to identify the temperament variables

as contributing incremental variance to the model. Since there was insufficient power to identify a small or medium effect size using this sample, a backward-entry regression identified the asocial personality disorder component as the only significant predictor of problem gambling severity among the personality disorders and temperament components.

Next, the secondary hypothesis was tested to see if the effects of gender as a potential moderator would influence the relation between the temperament and personality disorders as predictors of problem gambling severity. In the student sample, using both the PGOUT scale and the PGSI scale, gender did not moderate the association between any of the predictors and problem gambling severity. In the referred sample, using the PGSI scale, gender was a significant moderator for both impulsivity and positive affectivity. Although gender was a significant predictor of problem gambling severity in the student sample and a significant moderator in the referred sample, it did not affect the interrelation between the temperament and personality disorder variables and their prediction of problem gambling severity in the overall model.

DISCUSSION

Numerous personality and temperament descriptors have been proposed in the literature in an effort to identify the underlying determinants of problem gambling. Impulsivity and negative affectivity have been identified as key correlates of problem gambling severity (e.g., Blaszczynski & McConaghy, 1989; Gonzalez-Ibanez, Jimenez et al. 1999; Steel & Blaszczynski, 1996) and thus might be considered possible determinants of either problem gambling development or its exacerbation. Personality disorders have also been identified as common comorbid diagnoses among samples of problem gamblers (Blaszczynski, & Steel, 1998; Specker et al., 1995). The overlap between impulsivity, negative affectivity, and the personality disorders is not surprising, given that impulsivity and negative affectivity are often the defining characteristics of the personality disorders highlighted in these studies.

Investigation into personality psychopathology as it is related to problem gambling has centred largely upon antisocial personality disorder (Blaszczynski & McConaghy, 1997; Pietrzak & Petry, 2005; Steel & Blaszczynski, 1998). Other studies, however, have identified high rates of Cluster A personality disorders, the Odd/Eccentric Cluster which include schizoid, schizotypal and paranoid personality disorders (Black & Moyer, 1998) and narcissistic personality disorder (Steel & Blaszczynski, 1998). A limitation of past work is that it has not extended much beyond reporting comorbidity rates. The present study was undertaken to determine (i) if personality disorders contribute unique variance above and beyond the temperament variables in the prediction of problem gambling severity and (ii) if gender moderates the relation between the temperament variables and problem gambling severity. Although gender was a

significant predictor of problem gambling severity in the student sample and a significant moderator in the referred sample, it did not affect the interrelation between the temperament and personality disorder variables and their prediction of problem gambling severity in the overall model.

Following is a summary of the major design elements of the present study that constitute its strengths. The student sample consisted of 486 participants who reported gambling in the past 12 months recruited from a local university. The referred sample consisted of 95 individuals who gambled in the past 12 months as well and reported some difficulty related to their gambling habits. These individuals were recruited from community agencies.

In an effort to thoroughly cover the constructs outlined in this study, several measures of each construct under investigation were employed. Two personality disorder measures were included (the MCMI-III and PDQ-4) which identify dimensional scores for all ten personality disorders. Multiple measures relating to impulsivity (e.g., BRT-11: Non-Planning, Cognitive and Motoric; CAARS F Hyperactive-Impulsive scale; I7 Impulsivity, UPPS: lack of Premeditation, Urgency and lack of Perseverance); sensation seeking (I7 Venturesomeness and UPPS Sensation Seeking scales); and negative affectivity (PANAS Negative Affectivity, BDI-II and BAI scales) were included. Also examined were measures of reward and punishment sensitivity (TPQ: Novelty-Seeking, Harm Avoidance and Reward Dependence scales; BISBAS: BIS and BAS scales; GRAPES: Punishment Expectancy and Reward Expectancy scales). These were included because major theoreticians influenced by temperamental and neurobehavioral theories of addictions and impulse disorders have suggested these constructs as core higher-order

mechanisms in both impulsivity and negative affectivity (Fowles, 1987; Gray, 1981; Gray, 1987; Cloninger, 1987). Finally, a positive affectivity measure was included (e.g., PANAS Positive Affectivity) because it has been postulated to differentiate between depression and anxiety (Clark & Watson, 1991) and is also a correlate of the reward sensitivity measures (Fowles, 1987).

A Principal Components Analysis (PCA) was used to reduce the temperament and personality disorder measures into independent variables that contain the common variance among similar measures and to delineate the core constructs underlying these scales. The temperament variables in both samples were reduced to four components corresponding to the following constructs: impulsivity, sensation seeking, positive and negative affectivity. The personality disorder measures were similarly reduced and resulted in four components: Cluster A/B narcissistic, Cluster B impulsive, Cluster A asocial, and Cluster C anxious. The component scores were then used as predictors of problem gambling severity.

Two problem gambling severity measures were used in the student sample and one was used in the referred sample. In the student sample, the PGOUT variable was included which is a combination of DSM-IV criteria (APA, 2000), the Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001), and the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987). The PGSI was used as the dependent variable in the referred sample. To allow for a more precise of comparison between the participant samples, the PGSI was also used as a dependent variable in the student sample in addition to the PGOUT.

Testing the primary hypothesis

Once the independent variables pertaining to the temperament constructs were determined through data reduction, the interrelation between the temperament variables and the personality disorder variables as predictors of problem gambling severity was investigated. When the temperament variables were given the opportunity to account for variance in problem gambling, prior to the entry of the personality disorder components, three of the four temperament components accounted for a portion of variance, depending on the sample and the dependent variable (PGOUT or PGSI). In the student sample, impulsivity and negative affectivity were significant predictors using the PGOUT as the outcome measure of problem gambling severity. When the PGSI was used as the dependent variable, impulsivity and sensation seeking were significant predictors. In the referred sample, only the negative affectivity temperament component predicted problem gambling severity using the PGSI. The component containing the positive affectivity and behavioural activation system scales was not a significant predictor in either sample.

The primary goal of this study was to determine how much significant unique incremental variance in problem gambling was accounted for by personality disorder dimensions and how much was accounted for by temperament dimensions. This was represented initially by the primary hypothesis: personality disorder dimensions will account for at least some of the significant unique incremental variance over and above temperament variables. In order to determine if there are aspects of personality psychopathology that can account for problem gambling severity above and beyond the temperament variables, both sets of component scores were entered into a hierarchical regression analysis. Once the personality disorders were entered into the equation and

tested against the temperament variables, they performed better than expected. Not only did they account for variance above and beyond the temperament variables, they accounted for all of the significant variance in the equation when this hypothesis was tested in the student sample. Hence, when the order of entry was reversed, the temperament variables going in the second block, the resulting R^2chg was non-significant in the student sample. Controlling for gender effects in this sample (and recall that gender itself predicts problem gambling in this sample) did not alter the finding that the personality disorders completed accounted for all of the effects of temperament on problem gambling. In the referred sample, the results were essentially a draw; neither the personality disorder nor the temperament dimensions predicted any significant unique variance. Gender was not a significant predictor of problem gambling in this sample, but it did moderate slightly the effects of temperament in predicting problem gambling. And so it was interesting that when gender was controlled in this sample, again, the personality disorder dimensions predicted significantly unique incremental variance in problem gambling, but the temperament variables failed to do so. Thus, even when gender was controlled, in both these samples, one can reasonably conclude that the personality disorder dimensions fully accounted for the relation between temperament and problem gambling.

In the student sample, using the PGOUT as the outcome measure, the narcissistic and the impulsive personality disorder components fully accounted for the relationship between the temperament variables and problem gambling severity. When the PGSI was used as the outcome measure (again in the student sample) the impulsive personality disorder component fully accounted for the relationship between the temperament

variables and problem gambling severity. It is important to note that antisocial personality disorder has the highest loadings for the Cluster B impulsive personality disorder component in both samples. This supports the numerous assertions made in past studies that antisocial personality disorder predicts problem gambling severity (Blaszczynski & McConaghy, 1997; Pietrzak & Petry, 2005; Steel & Blaszczynski, 1998).

In the referred sample, there was only .62 power to detect a significant effect once all the temperament and the personality disorder components were entered into the model. With limited power, it was not possible to determine if the personality disorder variables accounted for variance above and beyond the temperament variables, even when gender was included as a control. An attempt was made, however, to ascertain which of these components was the most parsimonious in predicting problem gambling severity. The asocial personality disorder component was the only variable which reached significance, after controlling for the effects of other personality disorder and temperament dimensions. The Cluster A personality disorders explain problem gambling in a manner that is not addressed in any of the temperament variables selected in this study. This indicates that there is a social isolation aspect to gambling that has not been addressed in previous research apart from the previous identification of higher rates of Cluster A personality disorders in some samples of problem gamblers (Black & Moyer, 1998). Researchers (e.g., Blaszczynski & McConaghy, 1989) have identified anxiety as a more likely characteristic of problem gamblers who choose more isolative gambling methods such as slot machines, VLTs or, more recently, online gambling. According to the present findings, it may be more a willful isolation and a desire to engage in solitary

activities rather than an attempt to reduce anxiety (as would be hypothesized if the Cluster C component was a significant predictor). When the order of entry in the regression analysis was reversed it was found that the temperament variables did not account for any unique variance above and beyond the personality disorder variables in either sample. Therefore, the personality disorder variables not only accounted for variance above and beyond the temperament variables but also accounted for the temperament variance in a more parsimonious manner.

Testing the secondary hypothesis

It was not until recently that researchers began including female participants in their samples of problem gamblers even though women comprise approximately 1/3 of all gamblers (Volberg, 1994). Studies that included female participants indicated that there is a gender disparity in the manifestation of certain gambling correlates. For instance, women problem gamblers have been reported to have lower rates of impulsivity and higher rates of depression and anxiety than male gamblers (Ibanez et al., 2003; Specker et al., 1996). Given this finding, it was predicted that gender may moderate the association between impulsivity and negative affectivity with problem gambling. Specifically, impulsivity was expected to be a stronger predictor of problem gambling for males (Specker et al., 1996) and negative affectivity was predicted to be a stronger predictor for females (Ibanez et al., 2003; McCormick, 1994).

Were these hypotheses borne out by the data, it would suggest that the underlying factor structure of gambling correlates might also differ. This, however, did not prove to be the case in the present study. A comparison of the identified temperament and personality disorder components from the student sample using a Procrustes rotation

indicated that the components were highly correlated across gender (see appendix B). The same analysis was not possible using the referred sample because once the sample was divided by gender; the sample size was too small to identify the underlying factor structure in a reliable and replicable manner. The findings from the student sample suggest a uniform factor structure across gender and support combining the male and female data.

The secondary hypothesis tested gender as a possible moderator of the above findings. Once gender was accounted for, sensation-seeking was no longer a significant predictor using the PGSI in the student sample. This indicates that that original finding was likely confounded and was better accounted for by a gender effect, although this same finding was not observed when using the PGOUT as the dependent variable, and the PGOUT is admittedly the preferred indicator of problem gambling. The hypothesis that gender would moderate the relation between the temperament variables and problem gambling severity was not supported in the student sample. In the referred sample, negative affectivity was a significant predictor of gambling severity and gender moderated the relation between impulsivity and positive affectivity with problem gambling severity. Impulsivity was found to be a significant predictor of problem gambling for females only. This was an interesting finding given that it was originally expected that impulsivity would be a better predictor of problem gambling severity in males than in females (as suggested by Ibanez et al., 2003). The second significant interaction was between gender and the component containing the positive affectivity and behavioural activation system scales. When this effect was examined by gender, positive affectivity did not predict problem gambling in females but approached significance in

males. Given that there were only 32 males and 48 females who completed all of the temperament variables; it is possible that this finding failed to reach significance due to a Type II error since the sample size was not large enough to determine a significant finding in the male subset of the sample. Furthermore, when there is a disparity between the sizes of subgroups in a variable, this can further decrease the power of an analysis (Frazier, Tix & Barron, 2004). This finding indicates that an underactive behavioural activation system and/or low positive affectivity may predict problem gambling development in males but not in females. A larger sample would be required to properly test this supposition. If this finding holds true, it would contradict Gray's (1981, 1987) suggestion that impulsive behaviour may be explained by an overactive behavioural activation system. This is of course is assuming that problem gambling is best defined as an impulsive act. This finding may also pertain to the notion that low positive affectivity is a core characteristic of depression, according to Clark and Watson's (1991) tripartite model. This finding may simply indicate that the male problem gamblers in the referred sample have depressive, but not anxious symptoms that exacerbate their gambling problem.

CONCLUSIONS

Results of the present study substantially expand upon previous avenues of investigation. Previous research has generated considerable support for the inclusion of impulsivity and negative affectivity as predictors of problem gambling severity (Blaszczynski, Steel & McConaghy, 1997; Blaszczynski & McConaghy, 1989; Moran, 1970; Zimmerman, Meeland, & Krug, 1985; Petry, 2001). The findings of the present study suggest that a predisposition towards impulsive behaviour is a good predictor of problem gambling severity, but suggests that it might not be the best predictor. It would appear that, in the present study, the manifestation of impulsive personality disorder traits encompasses the variance accounted for by the construct of impulsivity and provides additional predictive power. Blaszczynski and Nower (2002) proposed an antisocial-impulsivity pathway as leading to the greatest degree of pathological gambling. The results of this study indicated that the label "antisocial impulsivist" is redundant as measures of impulsive personality disorders (likely antisocial personality disorder and borderline personality disorder) completely encompass this variability. That is, impulsivity as measured by impulsivity scales, rather than personality disorder scales, has no independent, statistically significant, unique ability to explain variance in problem gambling over and above personality disorder dimensions. The same can be said of the other aspects of temperament, which have been cited or implicated in the explanation of problem gambling. Our results suggest that personality disorder dimensions explain all there is to be explained in the set of temperament/affect and personality disorders.

There are many characteristics of gambling activities, such as the involvement of high stakes that are attractive to persons with pathological impulsive traits. Individuals

with antisocial personality disorder are often classified as "sensation-seekers" (APA, 2000), whereas individuals with borderline personality traits may attempt to regulate their emotions by gambling. It is important to note that there is no indication that individuals with personality disorders are more likely to develop gambling problems (Petry, Stinson & Grant, 2005) or that pathological gamblers are more likely to have personality disorders (Blaszczynski & Steel, 1998) compared to other psychiatric diagnoses. This finding suggests that a comorbid personality disorder is likely to exacerbate gambling problems and may also limit available internal and external coping resources (Blaszczynski & Steel, 1998).

Another interesting finding in this study was the ability of the asocial personality disorder component to significantly predict problem gambling severity in both samples. The fact that this was the main predictor in the sample reporting the greatest degree of problem gambling suggests that the diagnostic features comprised within this component may have been overlooked as potential predictors in the design of previous studies. This finding indicates that there is an asocial trait that is common among many problem gamblers that is not explained by anxiety or depression. Perhaps these are the people who populate the slot machines in casinos and, although surrounded by other people, are in a world unto themselves? Black and Moyer (1998) suggested that persons with Cluster A traits may "be preferentially attracted to gambling" (p. 1437), particularly to those forms of gambling that require little interpersonal contact, such slots or internet gambling.

Notable differences were found between the student sample and the referred sample in this study. In the student sample, gambling problems were related to impulsivity, negative affectivity, and the asocial, narcissistic and impulsive personality

disorders. In the referred sample, there was a much larger mood component with negative affectivity being the main temperament predictor of problem gambling severity. Additionally, impulsivity was also found to be a predictor among females in the referred sample. It may be that the results from the student sample are indicative of factors that lead to increased interest and participation in gambling activities whereas the results from the referred sample are more indicative of true problem gambling severity. It is also possible that these samples diverged in terms of qualitative differences in pathology. If, in fact, problem gamblers can be divided into different subgroups with varying etiology, sampling differences may have lead to more emotionally labile problem gamblers in the referred sample and more impulsive/narcissistic gamblers in the student sample. Such has been suggested by "subtype" theorists who hypothesize that different individuals have one of three or more distinct etiologies in the development of their problem gambling (Blaszczynski, & Nower, 2002). However, there has yet been no empirical evidence provided to support the claim that individuals go down different "pathways" to become problem gamblers, such as is required to support a subtype notion. Indeed, the present data do support the claim that there are several orthogonal dimensions (impulsive personality disorder traits, narcissistic personality disorder traits, etc.) associated with severity of gambling. Although our data have no bearing on this, these traits may be causal of problem gambling. Even if that were true, this does not mean that these different traits take residence in different people. The fact that that the traits are orthogonal is a feature of traits, and it doesn't mean that there are distinguishable types of people, whose problem gambling etiology is explicable by one set of traits, but not the others. If the traits are indeed causal, then, because they are orthogonal, there are indeed

bound to be some people who have high levels of one, but not the other. But the majority of problem gamblers are likely to have a mixture of both. This hardly would lay the foundation for a typology in any meaningful sense of the term. Rather, the clinician's job under those circumstances is the same with every problem gambler, namely, to ascertain the amount of each trait in the particular gambler, and then direct treatment to that trait or set of traits. If this holds true, we may eventually end up with specialized treatments for traits, but not specialized treatments for types of people.

Limitations of the Study

One of the main limitations of this study is the referred participants' sample size. It is likely that there was not sufficient power to identify all true effects. In particular, when performing a moderator analysis, unequal sample sizes decrease power. In both samples there was also a substantial discrepancy between the number of males and females, likely decreasing the chance of finding significant or non-spurious findings in the gender-related analyses (Frazier, Tix, & Barron, 2004).

There were also a large number of statistical tests performed in this study, which increased the probability of committing a Type I error. Type I errors are considered by some (i.e., Bakan, 1966) to be more serious than Type II errors as they are more likely to be reported given the current trend in the field of Psychology of only publishing significant findings. Furthermore, Bakan (1966) stresses that the publication of a Type I error tends to discourage further investigation. However, stringent Type I error control would have resulted in further loss of statistical power in this study. Therefore, it is important to be aware that one or many of the statistically significant findings may have

been due to chance. Hopefully future studies will attempt to replicate these analyses and confirm the findings.

Principal Components Analysis with an orthogonal rotation was selected as the method of data reduction for this study. While this method was ideally suited to retain as much variance as possible from the individually measures and clearly parse out the variance among the derived components, this is not the best method to identify the shared, underlying constructs among these scales. There were significant moderate correlations among the personality disorder components when they were rotated obliquely. Future studies should attempt to better identify and label the temperament and personality disorder variables using alternate factor analytic techniques.

Another limitation of the study was the heterogeneity of the referred sample. Obtaining sufficient referrals from the community was very difficult. Each referral source required REB approval from their site and they would often supply referrals for a limited time. As such, the referred sample contained participants with a wide range of concurrent disorders as well as a number of students from the university who were identified as potential problem gamblers.

The student sample, while large enough to ensure adequate power for the analyses, contained only a small percentage of problem gamblers (2.6-3.9% of the student sample met criteria according to the three problem gambling severity measures). While the student sample was sufficiently large enough to reliably test the hypotheses posited in this study, the range of problem gambling severity among the students sampled was somewhat restricted and this may limit the degree of generalizability of the results obtained with this sample. Furthermore, the student sample may further limit

generalization as age in this sample was positively skewed and university students, for the most part, come from a higher socio-economic status. Additionally, minorities were not well represented in this population compared to the demographics of the region. Thus, the sample collected through the participant pool was not sufficiently diverse in terms of age, gender, ethnicity, and problem gambling severity limiting its generalizability to the general public.

As this study is cross-sectional in design, it was not possible to establish a temporal ordering of the onset of the psychiatric symptoms. As noted earlier, there is some evidence that gambling problems may incite antisocial behaviours (such as lying and stealing), as well as lead to increased anxious and depressive symptoms. Additional screening to establish the temporal ordering of symptoms or possibly a longitudinal design would permit a better understanding of the causal relationship among these variables.

Lastly, since the personality data was collected via self-report, it could be considered biased. Individuals with personality psychopathology may have particular difficulty describing themselves accurately (Costa & McCrae, 1992). This may have been mitigated, to some degree by the web-based procedures that allowed for a greater degree of anonymity during completion. The web-based procedures may, however, be considered a limitation in that testing does not occur in a controlled environment. Participants were allowed to complete the questionnaires from home or any environment with Internet access. Thus, confounds such as noise levels and other distractions cannot be controlled via this method of data collection.

Implications of the Findings and Future Directions

The co-occurrence of one or many personality disorder diagnoses often greatly complicates the clinical picture and limits response to conventional treatments for Axis I disorders. Identifying the underlying psychopathology in a problem gambler is likely essential to identifying proper treatment goals (Petry, Stinson & Grant, 2005). In some, learning impulse control and alternate ways of seeking "thrills" may be useful. In others, treating the underlying depression or anxiety disorder may be most helpful. Narcissistic and antisocial features may lead to increased treatment resistance as these disorders are considered to be particularly ego-syntonic and individuals with these traits may have little insight into their dysfunctional traits or may not view them as problematic. Furthermore, these disorders can often lead to excessive externalization and preclude problem gamblers from taking responsibility for their actions (Blaszczynski & Steel, 1998).

Lastly, among more isolative problem gamblers, helping them explore their desire for social isolation and identify alternate pastimes may be the best treatment. In this group, developing treatment options may be a challenge as individuals with asocial personality disorders are generally less likely to seek treatment. Additional research in this area is essential to understanding which aspects of gambling meet particular needs for this group and why.

Future studies should continue to utilize measures of personality psychopathology in larger samples of problem gamblers in order to further explore how dysfunctional personality traits lead to the exacerbation of gambling problems. Attempts should be made to assess and include comorbid Axis I disorders such as other impulsive disorders and anxiety and mood disorders in order to ascertain whether or not subtypes of problem

gamblers do in fact exist. While this study had many limitations, its exploratory nature was also its strength, broadening of our understanding of new conceptualizations of factors that may exacerbate gambling problems and that may be capitalized on in future problem gambling research.

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Appendix A: Correlations among all variables

Table 4 *Correlations of all temperament variables and two problem gambling scales in the student data*

	1	2	3	4	5	6	7	8	9	10	11	12
1. PGOUT	1											
2. PGSI	.774**	1										
3. BAI	.103*	.074	1									
4. BDI	.144**	.111*	.594**	1								
5. BISBAS –BIS	-.069	-.087	.300**	.304**	1							
6. BISBAS –BAS	.018	.035	.031	-.057	.068	1						
7. BARRATT INP	.248**	.253**	.061	.161**	-.189**	.163**	1					
8. BARRATT IC	.129**	.084	.255**	.294**	.077	.211**	.481**	1				
9. BARRATT IM	.133**	.112*	.254**	.234**	-.015	.315**	.526**	.626**	1			
10. CAARS_B	.025	.050	.097*	.076	-.076	.115*	.188**	.139**	.293**	1		
11. CAARS_C	-.045	-.026	.169**	.150**	.090*	.054	.085	.214**	.273**	.561**	1	
12. CAARS_F	-.018	.011	.163**	.127**	.009	.058	.150**	.175**	.302**	.800**	.679**	1
13. GRAPES RE	-.022	.000	-.196**	-.321**	-.305**	.304**	-.029	-.177**	-.031	.050	-.022	.008
14. GRAPES PE	.043	-.034	.301**	.303**	.354**	.044	-.136**	.114*	.084	.031	.057	.080
15. I7 Impulsivity	.181**	.153**	.179**	.277**	-.035	.334**	.509**	.519**	.683**	.166**	.236**	.195**
16. I7 Vent'ness	.110*	.059	-.126**	-.091*	-.388**	.249**	.271**	.044	.193**	.181**	.022	.091*
17. PANAS PA	-.097*	-.044	-.255**	-.457**	-.140**	.275**	-.078	-.213**	-.019	.033	-.038	.028
18. PANAS NA	.093*	.136**	.597**	.611**	.342**	-.006	.071	.250**	.201**	.066	.117**	.116*
19. TPQ NS	.172**	.144**	.038	.086	-.216**	.340**	.578**	.422**	.551**	.176**	.123**	.154**
20. TPQ HA	-.014**	-.012	.357**	.480**	.502**	-.277**	-.084	.160**	-.009	-.077	.056	-.004
21. TPQ RD	-.074	-.035	.033	-.049	.342**	.082	-.166**	-.108*	-.074	-.005	.021	.005
22.UPPS PR	.097*	.073	.027	.095*	-.187**	.181**	.524**	.416**	.531**	.080	.098*	.067
23. UPPS UR	.221**	.140**	.359**	.400**	.241**	.275**	.302**	.475**	.550**	.114*	.233**	.161**
24. UPPS SS	.112*	.088	-.062	-.093*	-.369**	.316**	.286**	.089	.249**	.220**	.082	.132**
25. UPPS PS	.122**	.067	.241**	.334**	.029	.034	.414**	.484**	.400**	.057	.117**	.104*

Table 4 (cont)

Correlations of all temperament variables and two problem gambling scales in the student data

	13	14	15	16	17	18	19	20	21	22	23	24	25
1. PGOUT													
2. PGSI													
3. BAI													
4. BDI													
5. BISBAS –BIS													
6. BISBAS –BAS													
7. BARRATT INP													
8. BARRATT IC													
9. BARRATT IM													
10. CAARS_B													
11. CAARS_C													
12. CAARS_F													
13. GRAPES RE	1												
14. GRAPES PE	-.224**	1											
15. I7 Impulsivity	.023	.044	1										
16. I7 Vent'ness	.317**	-.283**	.206**	1									
17. PANAS PA	.467**	-.161**	-.023	.165**	1								
18. PANAS NA	-.246**	.306**	.179**	-.148**	-.260**	1							
19. TPQ NS	.084	-.144**	.622**	.408**	.074	.001	1						
20. TPQ HA	-.617**	.352**	-.018	-.467**	-.464**	.454**	-.225**	1					
21. TPQ RD	.084	.056	-.113*	-.117**	.251**	-.006	-.065	-.029	1				
22.UPPS PR	.016	-.200**	.584**	.262**	-.013	.013	.634**	-.145**	-.098*	1			
23. UPPS UR	-.162**	.218**	.594**	.044	-.175**	.378**	.410**	.243**	.056	.346**	1		
24. UPPS SS	.353**	-.213**	.240**	.850**	.189**	-.147**	.454**	-.495**	-.128**	.287**	.059	1	
25. UPPS PS	-.333**	.052	.372**	.040	-.268**	.244**	.401**	.276**	-.245**	.467**	.374**	.018	1

Table 5

Correlations of all temperament variables and the PGSI in the referred data

	1	2	3	4	5	6	7	8	9	10	11	12
1. PGSI	1											
2. BAI	.162	1										
3. BDI	.264*	.693**	1									
4. BISBAS –BIS	.019	.343**	.467**	1								
5. BISBAS -BAS	.097	.184	.128	.183	1							
6. BARRATT INP	.356**	.216	.208	-.041	.126	1						
7. BARRATT IC	.098	.102	.145	.058	.231*	.322**	1					
8. BARRATT IM	.163	.189	.279*	.118	.362**	.396**	.657**	1				
9. CAARS_B	.026	.060	.143	-.022	.268**	.184	.469**	.645**	1			
10. CAARS_C	.205*	.439**	.579**	.430**	.214*	.206*	.438**	.569**	.323**	1		
11. CAARS_F	.144	.264*	.340**	.132	.249*	.165	.526**	.675**	.832**	.528**	1	
12. GRAPES RE	.056	-.206	-.231*	-.102	.461**	-.112	.093	.197	.387**	-.104	.318**	1
13. GRAPES PE	.174	.412**	.383**	.314**	.221*	.008	.168	.249*	.077	.434**	.204*	-.105
14. I7 Impulsivity	.195	.336**	.410**	.166	.256*	.483**	.620**	.712**	.498**	.641**	.567**	.071
15. I7 Vent'ness	-.051	-.082	-.212	-.084	.410**	.279**	-.044	.148	.206*	-.160	.079	.433**
16. TPQ NS	.218*	.165	.151	.035	.311**	.545**	.424**	.548**	.397**	.398**	.460**	.160
17. TPQ HA	.245*	.356**	.470**	.441**	-.271**	.051	-.020	.025	-.282**	.401**	-.077	-.553**
18. TPQ RD	-.065	.052	-.089	.120	.006	-.113	-.009	-.048	.073	-.065	.087	.097
19. PANAS PA	-.156	-.252*	-.401**	-.217*	.222*	-.144	.106	.274**	.435**	-.070	.366**	.568**
20. PANAS NA	.298**	.611**	.668**	.379**	.096	.044	-.039	.148	.042	.458**	.155	-.236*
21.UPPS PR	.069	-.012	-.025	-.061	.060	.461**	.470**	.438**	.347**	.256*	.305**	-.026
22. UPPS UR	.291**	.284**	.406**	.288**	.147	.374**	.383**	.459**	.257*	.585**	.389**	-.156
23. UPPS SS	-.072	-.115	-.274*	-.203	.470**	.271**	.007	.187	.311**	-.189	.177	.510**
24. UPPS PS	.100	.026	.175	.141	.022	.302**	.437**	.332**	.108	.307**	.282**	-.310**

Table 5 (cont)

Correlations of all temperament variables and the PGSI in the referred data

	13	14	15	16	17	18	19	20	21	22	23	24
1. PGSI												
2. BAI												
3. BDI												
4. BISBAS -BIS												
5. BISBAS -BAS												
6. BARRATT INP												
7. BARRATT IC												
8. BARRATT IM												
9. CAARS_B												
10. CAARS_C												
11. CAARS_F												
12. GRAPES RE												
13. GRAPES PE	1											
14. I7 Impulsivity	.215*	1										
15. I7 Vent'ness	-.213*	.065	1									
16. TPQ NS	-.028	.599**	.333**	1								
17. TPQ HA	.469**	.105	-.480**	-.099	1							
18. TPQ RD	.058	-.034	-.084	-.007	.018	1						
19. PANAS PA	-.140	.040	.384**	.089	-.546**	.159	1					
20. PANAS NA	.422**	.240*	-.180	.090	.432**	.009	-.335**	1				
21.UPPS PR	-.210*	.571**	.144	.660**	-.120	-.056	.059	-.133	1			
22. UPPS UR	.356**	.604**	-.166	.471**	.402**	.066	-.228*	.400**	.331**	1		
23. UPPS SS	-.239*	.064	.867**	.345**	-.543**	.020	.477**	-.238*	.179	-.136	1	
24. UPPS PS	.146	.355**	-.176	.427**	.322**	-.085	-.199	.101	.441**	.368**	-.125	1

Table 6

Correlations of all personality disorder variables two problem gambling scales in the student data

	1	2	3	4	5	6	7	8	9	10	11	12
1. PGOUT	1											
2. PGSI	.774**	1										
3. PDQ Paranoid	.176**	.123**	1									
4. PDQ Schizoid	.133**	.124**	.358**	1								
5. PDQ Schizotypal	.188**	.145**	.568**	.455**	1							
6. PDQ Histrionic	.113**	.112*	.392**	.126**	.270**	1						
7. PDQ Narcissistic	.138**	.152**	.525**	.254**	.443**	.521**	1					
8. PDQ Borderline	.232**	.175**	.567**	.342**	.448**	.460**	.442**	1				
9. PDQ Antisocial	.265**	.248**	.425**	.310**	.408**	.400**	.428**	.574**	1			
10. PDQ Avoidant	.098*	.014	.373**	.290**	.338**	.190**	.240**	.408**	.064	1		
11. PDQ Dependent	.128**	.132**	.450**	.238**	.344**	.445**	.425**	.504**	.240**	.509**	1	
12. PDQ Obsessive Compulsive	.048	.008	.356**	.240**	.417**	.249**	.351**	.323**	.210**	.316**	.332**	1
13. MCMI Schizoid	.147**	.124**	.355**	.582**	.437**	.092*	.294**	.347**	.268**	.385**	.267**	.281**
14. MCMI Avoidant	.074	.026	.382**	.438**	.419**	.085	.230**	.367**	.141**	.638**	.420**	.318**
15. MCMI Dependent	.131**	.110*	.337**	.211**	.280**	.294**	.239**	.412**	.152**	.508**	.574**	.302**
16. MCMI Histrionic	-.147**	-.096*	-.310**	-.486**	-.402**	.030	-.200**	-.292**	-.160**	-.493**	-.284**	-.234**
17. MCMI Narcissistic	-.034	.056	-.058	-.209**	-.041	.115*	.229**	-.148**	.167**	-.459**	-.233**	-.064
18. MCMI Antisocial	.258**	.205**	.340**	.207**	.283**	.340**	.357**	.496**	.577**	.076	.240**	.178**
19. MCMI Compulsive	-.212**	-.170**	-.316**	-.185**	-.254**	-.304**	-.257**	-.533**	-.551**	-.119**	-.265**	-.093*
20. MCMI Schizotypal	.180**	.144**	.446**	.426**	.491**	.245**	.352**	.443**	.301**	.374**	.355**	.315**
21. MCMI Borderline	.265**	.223**	.518**	.359**	.484**	.403**	.423**	.686**	.514**	.356**	.499**	.360**
22. MCMI Paranoid	.131**	.078	.571**	.330**	.482**	.317**	.470**	.436**	.308**	.386**	.401**	.317**

Table 6 (cont)

Correlations of all personality disorder variables and the two problem gambling scales in the student data

	13	14	15	16	17	18	19	20	21	22
1. PGOUT										
2. PGSI										
3. PDQ Paranoid										
4. PDQ Schizoid										
5. PDQ Schizotypal										
6. PDQ Histrionic										
7. PDQ Narcissistic										
8. PDQ Borderline										
9. PDQ Antisocial										
10. PDQ Avoidant										
11. PDQ Dependent										
12. PDQ Obsessive Compulsive										
13. MCMI Schizoid	1									
14. MCMI Avoidant	.664**	1								
15. MCMI Dependent	.419**	.621**	1							
16. MCMI Histrionic	-.740**	-.783**	-.439**	1						
17. MCMI Narcissistic	-.235**	-.490**	-.408**	.438**	1					
18. MCMI Antisocial	.286**	.152**	.255**	-.085	.117*	1				
19. MCMI Compulsive	-.303**	-.207**	-.304**	.213**	.047	-.690**	1			
20. MCMI Schizotypal	.595**	.618**	.518**	-.558**	-.185**	.319**	-.344**	1		
21. MCMI Borderline	.524**	.520**	.607**	-.435**	-.166**	.572**	-.593**	.604**	1	
22. MCMI Paranoid	.536**	.540**	.449**	-.423**	-.079	.367**	-.316**	.617**	.579**	1

Table 7

Correlations of all personality disorder variables and the PGSI in the referred data

	1	2	3	4	5	6	7	8	9	10	11
1. PGSI	1										
2. PDQ Paranoid	.219*	1									
3. PDQ Schizoid	.238*	.428**	1								
4. PDQ Schizotypal	.202*	.598**	.637**	1							
5. PDQ Histrionic	.076	.399**	.286**	.572**	1						
6. PDQ Narcissistic	.174	.524**	.465**	.570**	.642**	1					
7. PDQ Borderline	.233*	.660**	.422**	.642**	.531**	.635**	1				
8. PDQ Antisocial	.284**	.433**	.332**	.337**	.193	.471**	.603**	1			
9. PDQ Avoidant	.043	.424**	.438**	.445**	.384**	.417**	.556**	.179	1		
10. PDQ Dependent	.089	.537**	.365**	.529**	.547**	.597**	.656**	.377**	.698**	1	
11. PDQ Obsessive Compulsive	.241*	.560**	.308**	.474**	.392**	.377**	.399**	.170	.278**	.368**	1
12. MCMI Schizoid	.289**	.407**	.663**	.592**	.219*	.383**	.423**	.318**	.419**	.380**	.304**
13. MCMI Avoidant	.206*	.425**	.506**	.488**	.212*	.407**	.528**	.220*	.785**	.539**	.295**
14. MCMI Dependent	.042	.432**	.379**	.603**	.481**	.423**	.658**	.259*	.625**	.698**	.349**
15. MCMI Histrionic	-.253*	-.353**	-.577**	-.452**	-.082	-.328**	-.436**	-.376**	-.577**	-.474**	-.209*
16. MCMI Narcissistic	-.112	-.105	-.186	-.139	.060	.030	-.325**	-.089	-.507**	-.381**	-.031
17. MCMI Antisocial	.253*	.342**	.308**	.376**	.338**	.477**	.523**	.596**	.147	.241*	.152
18. MCMI Compulsive	-.210*	-.474**	-.411**	-.473**	-.329**	-.539**	-.624**	-.684**	-.253*	-.480**	-.194
19. MCMI Schizotypal	.231*	.438**	.460**	.604**	.344**	.421**	.581**	.271**	.491**	.522**	.396**
20. MCMI Borderline	.231*	.577**	.398**	.609**	.497**	.572**	.805**	.545**	.426**	.543**	.328**
21. MCMI Paranoid	.229*	.695**	.429**	.622**	.388**	.575**	.677**	.359**	.490**	.525**	.521**

Table 7 (cont)

Correlations of all personality disorder variables and the PGSI in the referred data

	12	13	14	15	16	17	18	19	20	21
1. PGSI										
2. PDQ Paranoid										
3. PDQ Schizoid										
4. PDQ Schizotypal										
5. PDQ Histrionic										
6. PDQ Narcissistic										
7. PDQ Borderline										
8. PDQ Antisocial										
9. PDQ Avoidant										
10. PDQ Dependent										
11. PDQ Obsessive Compulsive										
12. MCMI Schizoid	1									
13. MCMI Avoidant	.584**	1								
14. MCMI Dependent	.368**	.559**	1							
15. MCMI Histrionic	-.721**	-.736**	-.455**	1						
16. MCMI Narcissistic	-.250*	-.574**	-.506**	.550**	1					
17. MCMI Antisocial	.355**	.182	.174	-.235*	.078	1				
18. MCMI Compulsive	-.348**	-.282**	-.392**	.364**	.119	-.633**	1			
19. MCMI Schizotypal	.570**	.605**	.573**	-.578**	-.282**	.229*	-.388**	1		
20. MCMI Borderline	.480**	.453**	.616**	-.399**	-.195	.677**	-.677**	.547**	1	
21. MCMI Paranoid	.580**	.556**	.524**	-.501**	-.187	.379**	-.477**	.576**	.578**	1

Appendix B: Identifying underlying factor structure of temperament and personality disorder variables.

This section provides additional detail regarding the use of principal component analysis in creating the independent variables in this study as well as evidence for factor invariance across both samples and gender.

The number of components selected for each PCA was based on the results of both parallel analysis (Horn, 1965) and the Minimum Average Partial test (MAP; Velicer, 1976). Both of these analyses were completed in SPSS using code provided in O'Connor (2000). In three of the four analyses, both parallel analysis and the MAP test suggested a four component solution. For the personality disorder variables in the *referred* dataset, parallel analysis suggested a two-component solution while the MAP test suggested a four-component solution. For ease of comparison between the results of the two datasets, as well as to allow for a greater differentiation among the different constructs underlying personality psychopathology, a four component solution was selected to reduce the personality disorder variables in the referred sample (see Table 29).

Table 29

Parallel Analysis eigenvalues for each Principal Component Analysis

	Temperament variables				Personality Disorder variables			
	Student data		Referred Data		Student data		Referred Data	
component	Obs.	Rand.	Obs.	Rand.	Obs.	Rand.	Obs.	Rand.
1	5.184	1.388	6.308	1.945	8.008	1.376	9.537	1.921
2	4.265	1.322	4.792	1.764	2.686	1.308	2.312	1.736
3	1.831	1.270	2.299	1.625	1.436	1.257	1.508	1.601
4	1.291	1.225	1.675	1.512	1.347	1.213	1.265	1.486
5	.980	1.185	1.051	1.408	.840	1.172	.847	1.382

PCA is often used as a data reduction technique to identify a small number of factors that explain as much of the variance as possible in a much larger number of manifest

variables. PCA has been described as the solution of choice for researchers primarily interested in reducing a large number of variables down to a smaller number of components (Tabachnick & Fidell, 2001). Several rotations were investigated to determine which would provide simple structure, clear interpretation and likely replicability. PCAs were completed using two of the available rotation options in SPSS, Varimax (which produces orthogonal components) and Promax (which produces oblique rotations, allowing the components to correlate). A principal components analysis using a Varimax (orthogonal) rotation was first selected as this would provide the added benefit of creating uncorrelated independent variables for the future regression analyses. This would allow each independent variable to account for incremental variance in the regression solution.

It is important to note that the sample size of the referred sample may limit the reliability and replicability of the loading pattern for this sample as it falls below the recommended 100 participant minimum and 5 participants per variable guideline proposed by some (i.e., Gorsuch, 1983). Others have suggested that the required sample size for exploratory factor analysis (EFA) is dependent on the communalities, with higher loadings and more marker variables requiring smaller sample sizes (Guadagnoli & Velicer, 1988). More conservatively, a minimum sample size of 300 is recommended for most EFAs but a sample size of 150 may be sufficient if the communalities for the variables are high (Comrey & Lee, 1992). For the temperament variables in the referred sample, the lowest communality is for the TPQ Reward Dependence variable (.118) and the rest range from .440 to .854.

Table 30

Varimax Rotated Component Matrix for the Student Sample

	Component			
	1	2	3	4
I7 –IMP	.805	.156	.117	.114
BRT –IM	.799	.185	.090	.115
UPPS -PM	.777	-.153	.136	-.073
TPQ –NS	.773	-.073	.317	.064
BRT –IC	.728	.215	-.096	-.069
BRT -INP	.722	-.063	.177	-.172
UPPS -PV	.631	.159	-.127	-.385
UPPS –UR	.623	.459	-.086	.162
BAI	.114	.795	.004	-.044
PANAS -NA	.108	.791	-.076	-.090
BDI-II	.201	.778	-.054	-.264
GRAPES -PE	-.054	.539	-.273	.141
UPPS -SS	.218	-.031	.871	.057
I7 -VENT	.184	-.065	.857	-.009
TPQ –HA	.004	.507	-.609	-.328
GRAPES -RE	-.116	-.245	.542	.481
BISBAS -BIS	-.058	.494	-.539	.308
TPQ –RD	-.108	.061	-.247	.651
PANAS -PA	-.064	-.367	.202	.646
BISBAS -BAS	.337	.092	.274	.588

Table 31

Varimax Rotated Component Matrix for the Referred Sample

	Component			
	1	2	3	4
BRT –IC	.806	-.008	.107	-.119
I7 –IMP	.775	.304	.124	.143
BRT –IM	.773	.193	.363	.073
UPPS -PM	.719	-.251	-.186	.342
TPQ -NS	.718	.059	.045	.509
UPPS -PV	.674	.017	-.393	-.026
CAARS -F	.653	.260	.438	-.115
UPPS -UR	.594	.466	-.191	.013
BDI-II	.197	.820	-.132	-.011
PANAS -NA	.032	.813	-.089	.053
BAI	.084	.790	-.026	.147
GRAPES -PE	.083	.652	.072	-.231

BISBAS -BIS	.039	.643	-.100	-.091
TPQ -HA	.053	.570	-.542	-.313
GRAPES -RE	-.019	-.142	.816	.120
PANAS -PA	.070	-.379	.724	.029
BISBAS -BAS	.222	.289	.584	.359
I7 -VENT	-.076	-.142	.446	.794
UPPS -SS	.005	-.182	.491	.756
BRT -INP	.452	.088	-.206	.668

Table 32

Varimax Rotated Component Matrix for the Student Sample

	Component			
	1	2	3	4
MCMI Schizoid	.818	.093	.212	.208
MCMI Histrionic	-.789	-.001	-.048	-.408
PDQ-4 Schizoid	.707	.175	.127	.021
MCMI Avoidant	.663	.138	.063	.601
MCMI Schizotypal	.613	.276	.288	.280
PDQ-4 Schizotypal	.545	.545	.161	.001
MCMI Paranoid	.487	.462	.266	.211
PDQ-4 Narcissistic	.184	.762	.237	-.074
PDQ-4 Histrionic	-.189	.665	.367	.128
PDQ-4 Paranoid	.328	.640	.266	.130
PDQ-4 Obsessive-Compulsive	.249	.580	-.034	.154
MCMI Compulsive	-.124	-.011	-.875	-.127
MCMI Antisocial	.114	.161	.837	-.034
PDQ-4 Antisocial	.205	.328	.702	-.178
MCMI Borderline	.352	.335	.637	.356
PDQ-4 Borderline	.178	.441	.595	.299
MCMI Narcissistic	-.217	.266	.083	-.760
MCMI Dependent	.198	.234	.260	.740
PDQ-4 Avoidant	.289	.320	-.049	.687
PDQ-4 Dependent	.010	.556	.202	.587

Table 33

Varimax Rotated Component Matrix for Referred Sample

	Component			
	1	2	3	4
PDQ-4 Histrionic	.798	.228	.131	-.088
PDQ-4 Obsessive-Compulsive	.707	-.045	.001	.305
PDQ-4 Schizotypal	.627	.273	.179	.482
PDQ-4 Narcissistic	.625	.473	.117	.188

PDQ-4 Paranoid	.611	.331	.147	.324
MCMI Paranoid	.552	.293	.239	.471
PDQ-4 Antisocial	.054	.833	.088	.175
MCMI Antisocial	.157	.826	-.099	.172
MCMI Compulsive	-.203	-.820	-.150	-.171
MCMI Borderline	.423	.686	.300	.194
PDQ-4 Borderline	.506	.593	.441	.168
MCMI Narcissistic	.200	.009	-.853	-.171
PDQ-4 Avoidant	.342	.058	.745	.272
MCMI Dependent	.475	.196	.696	.113
MCMI Avoidant	.190	.084	.673	.550
PDQ-4 Dependent	.529	.289	.625	.083
MCMI Schizoid	.171	.220	.176	.837
PDQ-4 Schizoid	.255	.225	.119	.731
MCMI Histrionic	.032	-.216	-.528	-.721
MCMI Schizotypal	.398	.168	.392	.507

Using an orthogonal rotation, on the other hand, may not be the preferred method as most personality variables are correlated to some degree. When this occurs, it is often preferable to utilize Oblique techniques that allow for the factors to correlate. Using the Promax rotation technique in SPSS with a Kappa of three provided a fairly simple and interpretable solution in each case (see Tables 34 to 37).

Table 34

PCA with Promax Rotation of Student temperament variables

	Component			
	1	2	3	4
BAI	-.048	.861	.168	-.030
BDI	.048	.809	.108	-.245
BISBAS -BIS	-.024	.410	-.515	.358
BISBAS -BAS	.313	.130	.227	.588
BRT -INP	.729	-.138	.100	-.165
BRT –IC	.745	.094	-.156	-.035
BRT –IM	.796	.103	.020	.139
GRAPES _RE	-.164	-.098	.525	.439
GRAPES _PE	-.099	.530	-.193	.169
I7 –IMP	.803	.077	.042	.135
I7 -VENT	.016	.134	.921	-.069
PANAS -PA	.003	-.332	.095	.632

PANAS -NA	-.038	.835	.082	-.070
TPQ -NS	.768	-.116	.225	.065
TPQ -HA	.015	.388	-.541	-.279
TPQ -RDO	-.032	.024	-.308	.676
UPPS -PR	.822	-.257	.016	-.061
UPPS -UR	.595	.386	-.096	.198
UPPS -SS	.046	.172	.933	-.001
UPPS -PV	.641	.035	-.160	-.358

Table 35

PCA with Promax Rotation of Referral temperament variables

	Component			
	1	2	3	4
BAI	-.044	.820	-.020	.179
BDI	.092	.807	-.113	.013
BISBAS -BIS	-.037	.643	-.078	-.065
BISBAS -BAS	.143	.345	.566	.338
BRT -INP	.366	.082	-.262	.669
BRT –IC	.859	-.148	.121	-.189
BRT –IM	.771	.106	.367	.008
CAARS -F	.663	.178	.461	-.178
GRAPES _RE	-.013	-.074	.810	.082
GRAPES _PE	.027	.640	.108	-.221
I7 –IMP	.747	.213	.123	.096
I7 -VENT	-.168	-.011	.378	.799
TPQ -NS	.671	.006	.005	.472
TPQ -HA	.017	.509	-.507	-.279
PANAS -PA	.125	-.352	.720	-.024
PANAS -NA	-.089	.838	-.076	.090
UPPS -PR	.738	-.351	-.221	.297
UPPS -UR	.552	.374	-.181	-.003
UPPS -SS	-.073	-.068	.426	.750
UPPS -PV	.703	-.123	-.392	-.059

Table 36

PCA with Promax Rotation of Student Personality Disorder variables

	Component			
	1	2	3	4
PDQ-4 Paranoid	.230	.626	.069	.024
PDQ-4 Schizoid	.741	.097	.021	-.130
PDQ-4 Schizotypal	.522	.532	-.037	-.146
PDQ-4 Histrionic	-.356	.682	.226	.114

PDQ-4 Narcissistic	.105	.807	.020	-.176
PDQ-4 Borderline	.009	.318	.510	.233
PDQ-4 Antisocial	.143	.202	.679	-.289
PDQ-4 Avoidant	.139	.288	-.203	.673
PDQ-4 Dependent	-.204	.536	.039	.589
PDQ-4Obsessive-Compulsive	.180	.636	-.244	.084
MCMI Schizoid	.822	-.046	.126	.053
MCMI Avoidant	.577	.023	-.054	.514
MCMI Dependent	-.002	.119	.179	.738
MCMI Histrionic	-.777	.126	.036	-.290
MCMI Narcissistic	-.113	.376	.059	-.805
MCMI Antisocial	.014	-.027	.886	-.111
MCMI Compulsive	-.002	.224	-.968	-.069
MCMI Schizotypal	.550	.160	.173	.155
MCMI Borderline	.196	.163	.572	.266
MCMI Paranoid	.407	.398	.106	.094

Table 37

PCA with Promax Rotation of Referral Personality Disorder variables

	Component			
	1	2	3	4
PDQ-4 Paranoid	.591	.151	-.021	.216
PDQ-4 Schizoid	.162	.075	-.065	.736
PDQ-4 Schizotypal	.603	.055	-.010	.393
PDQ-4 Histrionic	.877	.038	.021	-.253
PDQ-4 Narcissistic	.591	.333	-.046	.047
PDQ-4 Borderline	.372	.479	.332	-.041
PDQ-4 Antisocial	-.163	.916	-.025	.057
PDQ-4 Avoidant	.246	-.135	.734	.110
PDQ-4 Dependent	.449	.116	.583	-.134
PDQ-4Obsessive-Compulsive	.818	-.295	-.159	.263
MCMI Schizoid	.044	.074	-.007	.854
MCMI Avoidant	.046	-.095	.621	.450
MCMI Dependent	.393	.013	.675	-.095
MCMI Histrionic	.241	-.111	-.445	-.680
MCMI Narcissistic	.388	.054	-.965	-.049
MCMI Antisocial	-.009	.895	-.252	.080
MCMI Compulsive	-.007	-.853	-.025	-.024
MCMI Schizotypal	.322	-.025	.271	.421
MCMI Borderline	.272	.619	.170	.012
MCMI Paranoid	.502	.095	.068	.375

The SPSS Varimax solutions and the SPSS Promax solutions appeared to have conceptually similar loading patterns. This was verified by correlating the loadings with one

another (see Table 38 to 41). The results of the correlational analyses indicated that the Varimax and Promax loadings were very similar to one another.

Table 38

Varimax vs. Promax for the temperament variables in the student sample

	Promax 1	Promax 2	Promax 3	Promax 4
Promax 1	1			
Promax 2	.308**	1		
Promax 3	.300**	.499**	1	
Promax 4	.405**	.247**	.209**	1
Varimax 1	.968**	.145**	.145**	.212**
Varimax 2	.125**	.947**	.222**	.111*
Varimax 3	.122**	.271**	.961**	.076
Varimax 4	.183**	.094*	.083	.968**

Note. The correlation among the Varimax rotated components is .000.
*$p < .05$. **$p < .01$.

Table 39

Varimax vs. Promax for the personality disorder variables in the student sample

	Promax 1	Promax 2	Promax 3	Promax 4
Promax 1	1			
Promax 2	.252**	1		
Promax 3	.221**	-.357**	1	
Promax 4	.070	-.091	.150**	1
Varimax 1	.988**	.155**	.156**	-.047
Varimax 2	.118**	.972**	-.218**	-.038
Varimax 3	.098**	-.175	.961**	.083
Varimax 4	-.026	-.032	.069	.995**

Note. The correlation among the Varimax rotated components is .000.
*$p < .05$. **$p < .01$.

Table 40

Varimax vs. Promax for the temperament variables in the referred sample

	Promax 1	Promax 2	Promax 3	Promax 4
Promax 1	1			
Promax 2	.273*	1		
Promax 3	-.015	-.098	1	

Promax 4	.166	-.116	.139	1
Varimax 1	.987**	.130	-.006	.116
Varimax 2	.149	.991**	-.071	-.099
Varimax 3	-.002	-.025	.996**	.088
Varimax 4	.067	-.031	.045	.984**

Note. The correlation among the Varimax rotated components is .000.
*$p < .05$. **$p < .01$.

Table 41
Varimax vs. Promax for the personality disorder variables in the referred sample

	Promax 1	Promax 2	Promax 3	Promax 4
Promax 1	1			
Promax 2	.509**	1		
Promax 3	.400**	.343**	1	
Promax 4	.358**	.371**	.425**	1
Varimax 1	.935**	.222**	.174	.134
Varimax 2	.263*	.950**	.142	.163
Varimax 3	.175	.142	.953**	.193
Varimax 4	.164	.166	.204	.958**

Note. The correlation among the Varimax rotated components is .000.
*$p < .05$. **$p < .01$.

To ensure that other types of Varimax rotations would not be preferable to the SPSS Varimax solution, the Crawford-Ferguson analogue to Varimax was employed using Comprehensive Exploratory Factor Analysis (CEFA; Browne, Cudeck, Tateneni, & Mels, 2004). The Crawford-Ferguson Varimax technique is preferred to other Varimax techniques as it does not allow for the collapse of the factor space (Crawford & Ferguson, 1970). The CF Varimax oblique rotation, referred to as the primary parsimony criterion, is preferred to the direct oblimin criterion available in SPSS (Crawford, 1975). Using these solutions, none of the obtained loading patterns were easily interpretable. In some cases, additional variables had low communality scores (such as the GRAPES Reward Expectancy variable in the student sample) and would need to be removed from the solution. Furthermore, many of the loadings did not make sense conceptually, given past findings and the theoretical grouping of many of these variables. For example, in the referred sample, the variables considered to

measure impulsivity loaded onto multiple components, thus failing to identify the underlying construct that has been proposed to relate them.

Table 42

PCA CF-Varimax using CEFA Oblique rotation of student temperament variables

	Component			
	1	2	3	4
BAI	.687	.066	.021	-.097
BDI	.625	.093	.090	-.350
BISBAS -BIS	.541	-.321	-.106	.109
BISBAS -BAS	.223	.134	.269	.515
BRT -INP	-.136	.136	.663	-.174
BRT –IC	.155	-.055	.650	-.115
BRT –IM	.174	.032	.757	.083
GRAPES -RE	.188	.096	.158	.065
GRAPES -PE	-.115	.234	-.067	.546
I7 –IMP	.486	-.165	-.074	.044
I7 -VENT	.128	.017	.795	.081
TPQ -NS	.005	.915	-.027	-.006
TPQ -HA	-.141	-.007	-.014	.667
TPQ -RD	.678	.011	.019	-.152
PANAS -PA	-.080	.238	.705	.043
PANAS -NA	.390	-.334	-.034	-.438
UPPS -PR	.210	-.181	-.104	.408
UPPS -UR	-.194	.071	.739	-.073
UPPS -SS	.443	-.038	.539	.051
UPPS -PV	.064	.933	.001	.066

Table 43

Correlations among factors for CF-Varimax Oblique rotation of student temperament variables

	CF-V Oblique 1	CF-V Oblique 2	CF-V Oblique 3	CF-V Oblique 4
CF-V Oblique 1	1			
CF-V Oblique 2	-.217**	1		
CF-V Oblique 3	.198**	.294**	1	
CF-V Oblique 4	-.244**	.238**	-.020	1

*$p < .05$. **$p < .01$.

Table 44

PCA CF-Varimax using CEFA Oblique rotation of referred temperament variables

	Component			
	1	2	3	4
BAI	.772	-.021	.066	.085
BDI	.805	.024	.119	-.100
BISBAS -BIS	.558	-.028	.000	-.080
BISBAS -BAS	.259	-.066	.384	.473
BRT –INP	.162	.627	-.079	.391
BRT –IC	-.114	.397	.571	-.240
BRT –IM	.117	.266	.707	.052
CAARS -F	.176	.053	.740	-.050
GRAPES -RE	-.161	-.382	.489	.367
GRAPES -PE	.534	-.153	.170	-.126
I7 –IMP	.229	.431	.529	-.018
I7 –VENT	-.002	.064	-.070	.946
TPQ –NS	.061	.663	.253	.308
TPQ –HA	.502	.128	-.208	-.426
PANAS -PA	-.394	-.301	.512	.267
PANAS -NA	.800	-.054	.005	.034
UPPS –PR	-.251	.773	.141	.064
UPPS -UR	.386	.422	.218	-.150
UPPS –SS	-.058	.066	.032	.897
UPPS -PV	-.021	.630	.086	-.248

Table 45

Correlations among factors for CF-Varimax Oblique rotation of referred temperament variables

	CF-V Oblique 1	CF-V Oblique 2	CF-V Oblique 3	CF-V Oblique 4
CF-V Oblique 1	1			
CF-V Oblique 2	.190	1		
CF-V Oblique 3	.095	.286**	1	
CF-V Oblique 4	-.213	-.012	.232*	1

*$p < .05$. **$p < .01$.

Table 46

PCA CF-Varimax using CEFA Oblique rotation of student personality disorder variables

	Component			
	1	2	3	4
PDQ-4 Paranoid	.150	.112	.571	.146
PDQ-4 Schizoid	.566	.059	.206	-.084
PDQ-4 Schizotypal	.369	.051	.508	-.012
PDQ-4 Histrionic	-.299	.212	.535	.224
PDQ-4 Narcissistic	.069	.055	.732	-.026
PDQ-4 Borderline	-.001	.471	.302	.288
PDQ-4 Antisocial	.077	.587	.296	-.186
PDQ-4 Avoidant	.203	-.130	.159	.616
PDQ-4 Dependent	-.130	.071	.366	.617
PDQ-4 Obsessive-Compulsive	.125	-.063	.422	.181
MCMI Schizoid	.799	.150	.072	-.035
MCMI Avoidant	.627	-.020	.010	.444
MCMI Dependent	.083	.190	.018	.688
MCMI Histrionic	-.826	.006	.062	-.159
MCMI Narcissistic	-.202	.040	.406	-.618
MCMI Antisocial	-.013	.801	.059	-.073
MCMI Compulsive	-.022	-.891	.150	-.039
MCMI Schizotypal	.486	.190	.210	.162
MCMI Borderline	.183	.557	.172	.291
MCMI Paranoid	.348	.136	.400	.148

Table 47

Correlations among factors for CF-Varimax Oblique rotation of student personality disorder variables

	CF-V Oblique 1	CF-V Oblique 2	CF-V Oblique 3	CF-V Oblique 4
CF-V Oblique 1	1			
CF-V Oblique 2	.236**	1		
CF-V Oblique 3	.213**	.443**	1	
CF-V Oblique 4	.438**	.214**	.232**	1

*$p < .05$. **$p < .01$.

Table 48

PCA CF-Varimax using CEFA Oblique rotation of referred personality disorder variables

	Component			
	1	2	3	4
PDQ-4 Paranoid	.438	.058	.204	.266
PDQ-4 Schizoid	.144	-.051	.684	.070
PDQ-4 Schizotypal	.535	-.013	.436	.109
PDQ-4 Histrionic	.773	-.008	-.060	.081
PDQ-4 Narcissistic	.503	-.036	.170	.326
PDQ-4 Borderline	.367	.340	-.023	.549
PDQ-4 Antisocial	-.146	.016	.050	.837
PDQ-4 Avoidant	.287	.634	.194	-.079
PDQ-4 Dependent	.432	.492	.015	.168
PDQ-4 Obsessive-Compulsive	.530	-.037	.235	-.071
MCMI Schizoid	.011	-.045	.864	.067
MCMI Avoidant	.075	.553	.466	-.044
MCMI Dependent	.421	.581	-.007	.100
MCMI Histrionic	.243	-.383	-.704	-.114
MCMI Narcissistic	.265	-.858	-.028	-.003
MCMI Antisocial	.008	-.210	.105	.780
MCMI Compulsive	-.032	-.035	-.050	-.781
MCMI Schizotypal	.279	.235	.426	.064
MCMI Borderline	.282	.161	.055	.629
MCMI Paranoid	.384	.103	.381	.193

Table 49

Correlations among factors for CF-Varimax Oblique rotation of referred personality disorder variables

	CF-V Oblique 1	CF-V Oblique 2	CF-V Oblique 3	CF-V Oblique 4
CF-V Oblique 1	1			
CF-V Oblique 2	.246*	1		
CF-V Oblique 3	.317**	.425**	1	
CF-V Oblique 4	.417**	.217	.392**	1

*$p < .05$. **$p < .01$.

Table 50

PCA CF-Varimax using CEFA Orthogonal rotation of student temperament variables

	Component			
	1	2	3	4
BAI	.146	.691	-.056	.008
BDI	.214	.700	-.299	.011
BISBAS -BIS	-.098	.562	.107	-.331
BISBAS -BAS	.335	.059	.506	.192
BRT -INP	.673	-.082	-.170	.157
BRT –IC	.659	.226	-.114	-.036
BRT –IM	.790	.175	.079	.076
GRAPES -RE	.211	.154	.075	.097
GRAPES -PE	-.029	-.318	.531	.290
I7 –IMP	-.037	.496	.054	-.186
I7 -VENT	.817	.135	.075	.067
TPQ -NS	.199	-.180	.060	.862
TPQ -HA	-.041	-.327	.628	.082
TPQ -RDO	.130	.709	-.113	-.050
PANAS -PA	.749	-.108	.045	.280
PANAS -NA	-.052	.575	-.422	-.396
UPPS -PR	-.116	.123	.386	-.142
UPPS -UR	.724	-.151	-.083	.116
UPPS -SS	.598	.453	.059	-.025
UPPS -PV	.240	-.144	.131	.886

Table 51

PCA CF-Varimax using CEFA Orthogonal rotation of referred temperament variables

	Component			
	1	2	3	4
BAI	-.020	.084	.107	.753
BDI	-.069	-.077	.191	.826
BISBAS -BIS	-.096	-.070	.040	.562
BISBAS -BAS	.452	.424	.201	.221
BRT -INP	-.184	.468	.526	.101
BRT –IC	.210	-.154	.716	.019
BRT –IM	.437	.093	.703	.209
CAARS -F	.500	-.036	.540	.282
GRAPES -RE	.675	.267	-.062	-.169
GRAPES -PE	.067	-.136	.033	.565
I7 –IMP	.197	.059	.753	.312
I7 -VENT	.264	.877	-.012	-.174
TPQ -NS	.039	.396	.760	.061

TPQ -HA	-.432	-.361	.051	.545
PANAS -PA	.657	.186	.002	-.376
PANAS -NA	-.076	.033	.044	.779
UPPS -PR	-.133	.188	.760	-.215
UPPS -UR	-.106	-.060	.568	.449
UPPS -SS	.332	.832	.050	-.207
UPPS -PV	-.264	-.119	.629	.054

Table 52

PCA CF-Varimax using CEFA Orthogonal rotation of student personality disorder variables

	Component			
	1	2	3	4
PDQ-4 Paranoid	.619	.298	.247	.121
PDQ-4 Schizoid	.207	.577	.133	.063
PDQ-4 Schizotypal	.505	.460	.180	.039
PDQ-4 Histrionic	.613	-.110	.310	.076
PDQ-4 Narcissistic	.703	.217	.209	-.085
PDQ-4 Borderline	.484	.177	.535	.262
PDQ-4 Antisocial	.362	.191	.618	-.151
PDQ-4 Avoidant	.319	.306	-.036	.608
PDQ-4 Dependent	.548	.060	.178	.503
PDQ-4 Obsessive-Comp	.448	.225	.049	.154
MCMI Schizoid	.124	.795	.212	.196
MCMI Avoidant	.166	.670	.056	.592
MCMI Dependent	.275	.223	.238	.676
MCMI Histrionic	-.022	-.802	-.049	-.391
MCMI Narcissistic	.197	-.206	.067	-.680
MCMI Antisocial	.217	.108	.775	-.032
MCMI Compulsive	-.075	-.131	-.828	-.112
MCMI Schizotypal	.313	.561	.271	.277
MCMI Borderline	.388	.341	.604	.338
MCMI Paranoid	.470	.457	.248	.200

Table 53

PCA CF-Varimax using CEFA Orthogonal rotation of referred personality disorder variables

	Component			
	1	2	3	4
PDQ-4 Paranoid	.551	.366	.168	.260
PDQ-4 Schizoid	.301	.215	.140	.643
PDQ-4 Schizotypal	.646	.271	.148	.446

PDQ-4 Histrionic	.765	.191	.044	-.002
PDQ-4 Narcissistic	.607	.422	.079	.227
PDQ-4 Borderline	.547	.598	.410	.128
PDQ-4 Antisocial	.081	.783	.103	.161
PDQ-4 Avoidant	.404	.046	.680	.276
PDQ-4 Dependent	.547	.262	.533	.134
PDQ-4 Obsessive-Comp	.548	.061	.055	.231
MCMI Schizoid	.210	.225	.181	.802
MCMI Avoidant	.252	.091	.658	.509
MCMI Dependent	.529	.197	.606	.116
MCMI Histrionic	-.005	-.224	-.543	-.709
MCMI Narcissistic	.118	-.017	-.824	-.136
MCMI Antisocial	.194	.751	-.098	.180
MCMI Compulsive	-.243	-.760	-.129	-.165
MCMI Schizotypal	.420	.200	.363	.453
MCMI Borderline	.472	.664	.257	.181
MCMI Paranoid	.525	.324	.244	.416

Both the SPSS Promax rotated solutions and Varimax rotated solutions provided very similar, interpretable results. The oblique rotations identified small to moderate correlations among many of the components, particularly the personality disorder components (See Tables 38 to 41). Using correlated component scores may not be the most optimal solution from a statistical perspective given that the components will be utilized as independent variables in regression analyses. By allowing the components to correlate, the amount of variance distributed among the personality disorder variables would differ in comparison to the orthogonal temperament components. The Varimax rotated solution was particularly useful as it allowed for enabling of the identification of how much variance is accounted for by each component in the regression analyses due to the orthogonal rotation. As such, the Varimax solution was selected to create both the temperament and personality disorder independent variables.

Assessment of Component Convergence by Gender

Given that there have been significant findings in the literature using gender-based problem gambling models (e.g. Ibanez, et al., 2003; Martins, et al., 2004; Specker et al., 1996), the underlying structure of the temperament scales were examined for component convergence across gender. This was deemed important in order to support the combination of males and females into the same component scores. This test was done using the *student* sample given that the sample size is large enough to divide by gender. Using CEFA (Browne, Cudeck, Tateneni, & Mels, 2004), the factor loadings for the impulsivity, negative affectivity, sensation seeking and positive affectivity variables were compared by gender via a Procrustes Rotation towards a target structure. The component structure of the females in the *student* sample was assessed using PCA. The male data in the *student* sample was then subjected to a Procrustes rotation using the female data component loadings as the target structure.

Table 54

Procrustes comparison by gender of student data using CEFA

	Component							
	Females				Males			
	Negaff	Senseek	Impuls	Posaff	Negaff	Senseek	Impuls	Posaff
BAI	.696	-.049	.152	.007	.715	.018	.174	-.091
BDI-II	.693	-.089	.245	-.254	.768	.008	.174	-.241
BISBAS –BIS	.561	-.320	-.062	.169	.375	-.332	-.209	-.036
BISBAS –BAS	.121	.237	.353	.462	-.175	.302	.203	.492
BRT –INP	-.023	.123	.690	-.124	-.155	.164	.674	-.229
BRT –IC	.224	-.019	.689	-.080	.117	-.116	.614	-.169
BRT –IM	.186	.130	.775	.095	.137	-.014	.797	.157
GRAPES –RE	-.301	.320	-.067	.547	-.202	.347	-.028	.639

GRAPES –PE	.475	-.220	-.042	.066	.424	-.246	.023	.092
I7 –IMP	.130	.073	.817	.084	.156	.145	.765	.220
I7 –VENT	-.095	.861	.181	.006	-.087	.899	.176	-.081
PANAS –PA	-.313	.176	-.056	.537	-.429	.175	-.096	.601
PANAS –NA	.684	-.088	.140	-.095	.762	-.223	.175	-.019
TPQ –NS	-.079	.326	.732	.009	-.160	.395	.756	.030
TPQ –HA	.564	-.448	-.004	-.391	.473	-.497	-.093	-.455
TPQ –RD	.094	-.082	-.158	.382	.024	.042	-.101	.384
UPPS –PR	-.176	.151	.742	-.111	-.064	.246	.685	-.047
UPPS –UR	.425	-.022	.628	.092	.438	-.037	.511	.067
UPPS –SS	-.035	.935	.210	.064	-.135	.826	.226	.025
UPPS –PV	.153	-.072	.567	-.355	.205	-.022	.562	-.487

Table 55

Correlations between male and female component loadings of temperament variables in the student sample using Procrustes rotation

	Male data			
Female data	1	2	3	4
1	.955**	-.681**	-.222	-.486*
2	-.605**	.973**	.190	.271
3	-.139	.137	.982**	-.272
4	-.535*	.290	-.353	.965**

*$p < .05$. **$p < .01$.

Correlation between the target structure (the female component loadings) and rotation of male student data indicated a high degree of similarity between the two sets of data. The correlations for the negative affectivity loadings was .96, for the sensation seeking loadings was .97, for the impulsivity loadings was .98 and for the positive affectivity loadings was .97. This provides evidence for factor invariance across gender for these constructs and permits the merging of the male and female datasets. Gender invariance was not tested for the

referred sample as there were only 32 males and 48 females in the sample. This would not permit a reliable and replicable principal components analysis of the data.

Again using CEFA (Browne, Cudeck, Tateneni, & Mels, 2004) the two samples were examined to determine if the underlying factor structure for the two sets of variables (the temperament variables and the personality disorder variables) were similar. The component structure of the temperament variables in the *student* sample was assessed using PCA. The temperament variables in the *referred* sample were then subjected to a Procrustes rotation using the *student* data component loadings as the target structure.

Table 56

Procrustes rotation of temperament variables across samples

	Student				Referred			
	1	2	3	4	1	2	3	4
BAI	-.070	.009	.152	.687	.120	.101	.141	.736
BDI	-.298	.014	.215	.694	.053	-.055	.207	.823
BISBAS –BIS	.076	-.332	-.091	.558	.012	-.047	.039	.573
BISBAS –BAS	.488	.191	.336	.061	.472	.368	.323	.104
BRT_INP	-.160	.164	.671	-.086	-.225	.459	.520	.111
BRT –IC	-.122	-.029	.665	.221	.046	-.214	.730	-.018
BRT –IM	.090	.084	.784	.179	.324	.014	.788	.109
CAARS –F	.078	.099	.208	.158	.424	-.111	.632	.175
GRAPES –RE	.562	.286	-.041	-.305	.645	.193	.078	-.316
GRAPES –PE	.042	-.186	-.035	.498	.161	-.127	.060	.546
I7 –IMP	.097	.077	.805	.141	.103	.006	.793	.261
I7 –VENT	.064	.864	.191	-.180	.293	.839	.095	-.268
TPQ –NS	.600	.079	-.039	-.321	-.065	.347	.780	.031
TPQ –HA	-.128	-.048	.135	.705	-.341	-.300	-.034	.639
TPQ –RDO	.042	.285	.752	-.113	.109	-.045	-.146	.034

PANAS –PA	-.452	-.393	-.042	.566	.571	.103	.122	-.510
PANAS –NA	.386	-.145	-.119	.129	.081	.060	.065	.777
UPPS –PR	-.093	.121	.734	-.163	-.307	.152	.722	-.194
UPPS –UR	.057	-.019	.598	.454	-.126	-.068	.550	.463
UPPS –SS	.141	.887	.230	-.142	.335	.782	.164	-.311
UPPS –PV	-.417	-.027	.556	.149	-.378	-.124	.559	.111

Table 57

Correlations between student and referred loadings of temperament variables using procrustes rotation

	Referred sample			
Student sample	1	2	3	4
1	.362	.319	.011	-.045
2	.218	.770**	-.054	-.458*
3	-.337	-.107	.564**	-.177
4	-.144	-.600**	-.272	.651**

*$p < .05$. **$p < .01$.

The results of this Procrustes rotation indicate that while the components derived from each sample are similar, these findings do not provide conclusive data that the factor structure is invariant across samples. In order to more accurately determine this, a larger sample of clinically referred problem gamblers would be needed to more reliably identify the underlying structure of these variables within this population.

When the two variables that were not invariant across samples due to their communality loadings (the CAARS -F and the TPQ Reward Dependence) were removed and the procrustes rotation was re-run, the correlations among the component loadings were higher.

Table 58

Procrustes rotation of temperament variables across samples excluding CAARS-F and TPQ Reward Dependence

	Student				Referred			
	1	2	3	4	1	2	3	4
BAI	-.107	.014	.144	.688	-.073	.064	.110	.747
BDI	-.328	.044	.223	.677	-.143	-.100	.168	.809
BISBAS –BIS	-.067	-.323	-.095	.526	-.114	-.086	.025	.561
BISBAS –BAS	.524	.142	.302	.114	.495	.353	.295	.265
BRT –INP	-.090	.175	.680	-.083	-.206	.416	.552	.105
BRT –IC	-.094	-.022	.666	.226	.158	-.243	.723	.026
BRT –IM	.133	.071	.770	.201	.332	.017	.736	.224
GRAPES –RE	.641	.225	-.078	-.240	.717	.234	.030	-.131
GRAPES –PE	-.012	-.193	-.046	.501	.041	-.154	.023	.573
I7 –IMP	.158	.062	.794	.174	.129	-.036	.780	.326
I7 –VENT	.162	.865	.187	-.170	.302	.865	.097	-.143
TPQ –NS	.593	.030	-.072	-.281	-.027	.324	.791	.069
TPQ –HA	-.169	-.033	.130	.706	-.475	-.351	-.029	.522
PANAS –PA	.111	.279	.753	-.100	.616	.188	.072	-.349
PANAS –NA	-.551	-.343	-.019	.517	-.123	.021	.035	.773
UPPS –PR	-.029	.128	.746	-.159	-.198	.130	.762	-.222
UPPS –UR	.040	-.019	.587	.463	-.186	-.112	.542	.444
UPPS –SS	.250	.860	.222	-.125	.360	.814	.159	-.174
UPPS –PV	-.386	.010	.578	.129	-.360	-.149	.576	.033

Table 59

Correlations between student and referred loadings of temperament variables using procrustes rotation excluding CAARS –F and TPQ Reward Dependence

	Referred sample			
Student sample	1	2	3	4
1	.684**	.494*	.134	-.496*
2	.481*	.836**	-.054	-.656**
3	.019	-.097	.658**	-.397
4	-.525*	-.689**	-.363	.903**

*$p < .05$. **$p < .01$.

While the correlations among the component loadings were notably higher with the CAARS F and TPQ Reward Dependence variables excluded from the analysis, the

correlations are not high enough to indicate invariance across the two samples. This suggested that the two populations differ in terms of the underlying factor structure for the temperament variables.

The same analysis was conducted for the personality disorder variables to determine if they have the same underlying factor structure across both samples. The *student* data loading pattern was again used as the target structure for the *referred* data.

Table 60

Procrustes rotation of personality disorder variables across samples

	Component							
	Student				Referred			
	1	2	3	4	1	2	3	4
PDQ-4 Paranoid	.619	.298	.247	.121	.548	.302	.335	.170
PDQ-4 Schizoid	.207	.577	.133	.063	.302	.668	.167	.068
PDQ-4 Schizotypal	.505	.460	.180	.039	.644	.478	.225	.137
PDQ-4 Histrionic	.613	-.110	.310	.076	.763	.015	.167	.114
PDQ-4 Narcissistic	.703	.217	.209	-.085	.615	.260	.389	.091
PDQ-4 Borderline	.484	.177	.535	.262	.526	.222	.584	.417
PDQ-4 Antisocial	.362	.191	.618	-.151	.101	.221	.771	.056
PDQ-4 Avoidant	.319	.306	-.036	.608	.339	.374	.037	.669
PDQ-4 Dependent	.548	.060	.178	.503	.502	.225	.253	.551
PDQ-4 Obsessive-Comp	.448	.225	.049	.154	.545	.239	.029	.075
MCMI Schizoid	.124	.795	.212	.196	.211	.831	.170	.076
MCMI Avoidant	.166	.670	.056	.592	.195	.604	.071	.596
MCMI Dependent	.275	.223	.238	.676	.474	.214	.192	.626
MCMI Histrionic	-.022	-.802	-.049	-.391	.032	-.793	-.195	-.424
MCMI Narcissistic	.197	-.206	.067	-.680	.197	-.257	-.039	-.778
MCMI Antisocial	.217	.108	.775	-.032	.232	.208	.727	-.132
MCMI Compulsive	-.075	-.131	-.828	-.112	-.259	-.228	-.743	-.098

MCMI Schizotypal	.313	.561	.271	.277	.395	.512	.169	.328
MCMI Borderline	.388	.341	.604	.338	.470	.255	.644	.249
MCMI Paranoid	.470	.457	.248	.200	.515	.465	.286	.222

Table 61

Correlations between student and referred loadings of personality disorder variables using procrustes rotation

	Referred sample			
Student sample	1	2	3	4
1	.891**	.287	.541*	.341
2	.269	.981**	.315	.548*
3	.475*	.302	.963**	.137
4	.342	.582**	.166	.964**

*$p < .05$. **$p < .01$.

The results of this analysis indicated that the component structure underlying the personality disorder scales were invariant across the two samples.

The results of the above analyses indicated that the underlying factor structure for the temperament variables is invariant in the student sample. There is less support for the invariance of the temperament variables across the student and referred samples. This could be due either to the qualitative differences between the samples or due to the small sample size of the referred sample.

Appendix C: Participant Recruitment Information Sheet

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PSYCHOLOGICAL DISINHIBITION MECHANISMS
Principal Investigator: Stephen Hibbard, Ph.D. Department of Psychology,
University of Windsor: 519 253-3000 ext. 2248

Disinhibition mechanisms are psychological or brain processes that lead people to do things that normally they would not do or that may be harmful to themselves or to others. In recent years, researchers have identified some good methods of studying these processes. It is believed that problems in these areas are partly responsible for some kinds of emotional problems or difficulties in living that some people have. Often, these people are given quite different psychiatric "labels". Therefore, we are asking various individuals to come to our lab to participate in a study of disinhibition mechanisms. Disinhibition refers to the fact that some people have a hard time stopping themselves from doing things they don't want to do or that they later regret. People with different emotional make-ups are being solicited for the study.

The study is being conducted at the University of Windsor. Various referral sources, including the person who gave you this sheet, have volunteered to help us find people who might be suitable for this study. People are coming from different clinics, from the University, and from the general population. If you participate, you would be asked to contribute 5 hours of your time on one occasion at our lab in Chrysler Hall on the Windsor campus. You will be compensated $60.00 in either gift certificates for the mall, or grocery store. You will do tasks that study your reaction time and your decision processes. You will also be administered a diagnostic interview. No medicines are administered. No wires are attached to you, nor are any physical procedures involved. You will also fill out questions regarding personality and emotions, which you may or may not have. People of various backgrounds are participating in this study. The results will be entirely confidential within ethical and legal limits. No one at the University (except the researchers) will have any idea how you were referred to the study or why you are there except to participate in some research. By the same token, no one who may have referred you to the study will get feedback or information about you that you have told to the researchers (unless you tell the researchers something they are legally required to follow up on, such as child abuse or the intention to commit suicide). They will not know whether or not you have participated in the study.

If you would like further information about participating please call the research team at 519 253-3000 ext. 2250. If your call is not answered immediately, please leave a number and a convenient time to reach you. Your call will be treated completely confidentially. There is a telephone screening process that will take 10 to 15 minutes. After that call, if you are still interested and if you meet the needs of the study, you will be asked to come to the University for the 5 hour period. If you are interested, just call the following number: 519 253-3000, ext. 2250. Please realize some people who call will not be able to participate because they may not fit the exact needs of the research.

Appendix D: Mechanisms of Impulsivity Recruitment Poster for Problem Gamblers

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ONTARIO ♦ CANADA

Primary Investigator: Dr. Stephen Hibbard, Department of Psychology

Interested in Research?

Have you ever:

- **Felt depressed or anxious after you gamble?**
- **Felt guilty about gambling?**
- **Had problems because of your gambling?**
- **Hidden your gambling from family/friends?**
- **Been criticized about your gambling?**
- **Gambled to win back past losses?**
- **Gambled to pay of your debts?**
- **Only stopped gambling because you ran out of money?**

If you said yes to most or all of these questions and are interested in being a research participant, please call 253-3000, ext. 2250

compensation for your time is provided □

Appendix E: Information for Students recruited from the Participant Pool for the Referral Sample

Bonus Points and Cash Opportunity

Hi! Your name was generated from a list of people who registered for the Psychology Research Participant Pool. We are the Impulsivity Research Group, lead by Dr. Stephen Hibbard, and we are conducting a study looking at different mechanisms of disinhibition, which in other words, means the ways in which people have trouble stopping themselves from doing things they do not really want to do, or at least before they are ready.

What do I have to do?

(a) Complete a 10-15 minute phone interview.
(b) If you're a good match for the study, you'll come into the research lab, 283-3 in Chrysler Hall South, where you will spend about 4.5 - 5 hours doing the following:

i. Complete some interview questions about emotional and diagnostic issues that you may or may not have.
ii. Complete 3 computer tasks, on one of which you could win a small amount of cash (less than $10).
iii. Complete personality and emotional problems questionnaires.

What do I get out of this? If, after the telephone interview, we don't think you'd be a good match for the study, you'll get one bonus point. If you are a good match, you will receive 3 bonus points and $30 in Devonshire mall gift certificates, in addition to any money you win on the computer task. During the two breaks when you come into the lab, we supply snacks and juice.

Potential Risks: Nothing is done to people physically in this study. Some of the questions that are asked might bring up feelings that are scary, sad, or otherwise uncomfortable for you if they remind you of any emotional difficulties you might have.

Potential Benefits: The compensation you receive (3 bonus points and $30 in gift certificates); potential interest in taking part in a research study; taking part in a study that will likely be of benefit to researchers who try to understand the relationship of disinhibition to emotional problems.

Ok, I'm interested, what do I do now? Respond to this email in the next few days, stating what day and time of day is best to reach you to do the telephone interview and we'll do our best to accommodate it. You can also leave a voice message at 253-3000, ext. 2250 stating your name and the day and time that it is best to reach you.

Appendix F: Mechanisms of Impulsivity Gambling Telephone Screen

Eight Gambling Screen

7. a) Have you ever felt depressed or anxious after a session of gambling?	NO	YES
7. b) Have you ever felt guilty about the way you gamble?	NO	YES
7. c) Has gambling ever caused you problems?	NO	YES
7. d) Have you found it better to not tell others, especially your family about the amount of time or money you spend gambling?	NO	YES
7. e) Have you often found that when you stop gambling it is because you ran out of money?	NO	YES
7. f) Do you ever get the urge to return to gambling to win back losses from a past session?	NO	YES
7. g) Have you ever received criticism about your gambling in the past?	NO	YES
7. h) Have you tried to win money to pay debts?	NO	YES

Appendix G: Consent Form for Referral Sample

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CONSENT TO PARTICIPATE IN A RESEARCH PROJECT
PSYCHOLOGICAL DISINIHIBITION MECHANISMS

PRINCIPAL INVESTIGATOR: STEPHEN HIBBARD, PH.D.
DEPARTMENT OF PSYCHOLOGY
UNIVERSITY OF WINDSOR
(519) 253 -3000 ext. 2248

Purpose of the study. In this study, we are trying to look at different "mechanisms of disinhibition" in various people. Psychologists tend to study many of these "mechanisms" from different points of view. "Mechanisms of inhibition" just means how people stop themselves from doing things they don't want to do. Mechanisms of *dis*inhibition means the ways in which some people have trouble stopping themselves. People who are disinhibited often have trouble in stopping themselves from doing things they might not really want to do or at least before they are ready. This study uses different lab assessment tasks to look into this in various people.

Procedures of the study. A) Tasks. You will be asked to do various lab tasks in this study. In two of these you will be asked to press a key on the computer keyboard when a certain signal comes up. In a third, you will learn which of different numbers are the ones that will give you a small monetary reward. In two others, you will judge whether certain figures on pieces of paper are the same (or similar) or not. You have a chance of winning a small amount of cash (less than $10.00). You have no risk of losing any money. B) Interview. There will also be some interview questions that the researchers will ask you. These questions are about emotional problems and diagnostic issues that you may or may not have. C) There will also be some personality and emotional problem questionnaires that you will answer. These are answered on computer.

Potential risks. There is nothing done to people physically in this study. There are no wires attached and nothing is put into anyone. No drugs will be administered. Some of the questions that are asked about emotional problems may bring up feelings in you that are scary, sad or otherwise uncomfortable for you if they remind you of your emotional difficulties.

Potential benefits. This is not a treatment study. Nobody is offering treatment in this study and no one is collecting information that might be used to help you later. So there is no direct benefit to you other than the compensation you will receive. Your participation in the lab tasks might be interesting to you because they are sort of like games. This study will likely be

of benefit to researchers who try to understand the relationship of disinhibition to emotional problems.

Payment. You will be remunerated $60.00 in either mall or grocery gift certificates for your participation. Your parking fees will also be paid to you and you may keep any money you earn in the lab tasks.

Confidentiality. The researchers who collect your data will keep your identity completely confidential, except in rare cases when they are ethically required to do otherwise. Data collected from you will be coded to an identification number that is not linked to your name in any way. Once you sign this form you are assigned this number and your name will never be connected to the data you give. The only place we will collect your name after you start the study is your signature on the receipt for compensation. This will never be linked with any data collected from you. There are a few situations in which researchers might be ethically required to break confidentiality. These include a credible indication of current suicidal or homicidal intent or the disclosure of child abuse. If you participate in the study, you give your consent for the researchers to break confidentiality in these instances.

Withdrawal from the study. You may withdraw from the study at any time with no further obligation. You will be paid on a pro rated basis for the amount of time you spent in the lab. That is, you will be paid for the fraction of the full 5 hour study time that you actually participated: time you spent in study/5 hours x $60.

You may withdraw your consent at any time and discontinue without penalty. This study has been reviewed and received ethics clearance through the University of Windsor Research Ethics Board. If you have problems regarding your rights as a research subject, contact:

Madeleine Mekis
Research Ethics Co-ordinator
University of Windsor
Windsor, Ontario N9B3P4

Telephone: 519-253-3000, ext. 3916
E-mail: ethics@uwindsor.ca

I hereby acknowledge that I have read both sides of this consent form and I freely agree to participate in the study.

_____
Printed name

_____ _____
Signature Date

Copy of the consent: I have received a copy of this consent form to take with me._____ Initials

Appendix H: Information sheet sent to potential participants for student sample

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Dear Participant Pool Student,

We are Michelle Carroll and Kristin Stevens, two graduate students in the department of Psychology working under the supervision of Dr. Stephen Hibbard. We received your name and e-mail address from the Psychology Participant Pool office as a psychology student who is interested in participating in research in exchange for bonus points in a psychology class. You are eligible to receive up to three (3) bonus marks for your participation in this study for psychology courses in which the professor is offering extra credit for research participation. The study concerns disinhibition mechanisms (the ways in which people have trouble stopping themselves from doing things they do not really want to do) and gender differences as they predict personality and emotional problems. We are asking students to complete a number of questionnaires on personality, and emotional well-being.

We have tried to make our data collection methods as simple and user-friendly as possible. For this purpose, we have created a website where participants may complete the questionnaires at their convenience from any computer with high speed Internet access (i.e., from your home or from the U of W campus). However, there is one requirement in order to participate in the study. You must have an e-mail address that you regularly check in order to receive messages from us during the study. The questionnaires take approximately 2-1/4 hours to complete. If you opt to participate in our study, once we send you a UserID and Password, you would have one week to complete the questionnaires before the Password expires. While we ask that you answer all of the questionnaires in one session, if you run out of time or become too tired, you can logout and return to the website at a later time to complete the rest of the questionnaires. After completion of the questionnaires no later than one week after receiving your password, you would notify us by e-mail that you have completed. You would then receive your bonus points. You may at any time notify us that you have decided to withdraw from the study without penalty. Once you receive the password, the software used to implement the study advises us whether or not you have completed the questionnaires. This is so we may monitor progress. Four days prior to the expiration of your password (three days after you receive it), if you have not completed the questionnaires, you will receive a reminder to complete them. It is very important that you comply with this reminder, because the password expires one week after you receive the password. When you complete the questionnaires, you will send us an e-mail and we will notify the Participant Pool to award your bonus points in the participating Psychology course you have so designated. If you do not comply with the reminder to complete the questionnaires, it is assumed you have decided not to participate, and your name will be returned back to the participant pool. We check our e-mail daily and we strongly encourage your requests for help of any sort in participating in this study. When we conclude the study, we will post a summary of the results on the University of Windsor Research Ethics Board website at www.uwindsor.ca/REB.

You would not need to worry about confidentiality of your responses because all your data would be coded to a research number that is not associated with your student ID number, your name, or any other identifying information. All of your responses will remain completely confidential.

If you wish to participate, please reply to this message and we will send you the web address and your UserID and Password for the study. Make sure you also specify to which course(s) you would like the three (3) bonus marks assigned, and of course, make sure that the professor in that course is actually offering bonus point credit for research participation.

Hope to hear from you soon,

Kristin and Michelle

Appendix I: e-mail conveying username and password to participant

Here is your username and password to participate

Dear X,

Thank you for agreeing to participate in our study. Here is your Userid and Password:

Userid:

Password:

The survey can be found at the following Web Site:

www.uwindsor.ca/pg

If you haven't already done so, please send us the course(s) you would like the three (3) bonus marks assigned to, including your section number.

If you need help completing the questionnaires please click on the Help Site link for further instructions. You may also contact us at any time via e-mail if you have any questions or problems with the web site.

You will receive three (3) bonus marks for participating in this study. If you haven't already, make sure you let us know which course(s) you would like the three (3) bonus marks assigned to.

You have one week to complete the survey in order to receive your bonus marks. Please send us an e-mail when the survey is complete so that we can ensure your bonus marks are submitted.

Thanks,

Kristin and Michelle

Appendix J: Main Login Form on Website for Student Data Collection

Project Title: DISINHIBITION MECHANISMS AND GENDER IN A STUDENT POPULATION

Principal Investigators: Michelle Carroll, M.A. and Kristin Stevens, B.A.

Faculty Sponsor: Stephen Hibbard, Ph.D.

For this study you are asked to complete a number of questionnaires pertaining to how you act and your beliefs about yourself and your behaviour. While this site is as user-friendly as possible, completing these questionnaires is time-consuming and may take you a few hours. Please try to complete all of the questionnaires in one sitting. It is important for the validity of the findings that you be in the same state of mind (i.e. mood) when completing all of the questionnaires. However, you may not have time to complete all of the questionnaires at once or may experience technical difficulties or have unexpected interruptions. For these reasons, this website was developed so that you may return to the login page and continue to complete the questionnaires on more than one occasion. This website is set up so that you have one week to complete all of the questionnaires before your Username and Password expire.

If you need to come back to any of the questionnaires, return directly to this login site and click on the link for the questionnaire where you left off.

If you have any problems completing the questionnaires or would like more information about this study please go to http://www.uwindsor.ca/pg and click on the Help completing the questionnaires link in the Table of Contents or contact Kristin Stevens via e-mail at any time at k_study@cogeco.ca.

You are also free to review the consent form that you must submit at the beginning of the study at any time by clicking on the this link: Consent form

Many of the questions within and across the questionnaires are similar to one another. It is very important for the accuracy of the results of this study that you answer all of the questions as truthfully as possible. Also, please complete the questionnaires in the order that they appear in the table of contents.

Thank you for participating in this research,

Michelle Carroll and Kristin Stevens

Appendix K: Consent form for participants for student sample

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Consent to Participate in Research

Project Title: DISINHIBITION MECHANISMS AND GENDER IN A STUDENT POPULATION

Principle Investigator: Michelle Carroll, M.A., and Kristin Stevens, B.A.

Faculty Sponsor: Stephen Hibbard, Ph.D.

After reading each point, indicate that you understand each point by clicking on the box.

At the end of the form, if you agree to participate, click on the "I consent to participate" button. If you have any questions contact the principle investigators via e-mail: k_study@cogeco.ca

1. General purpose. For the past few years, studies have been conducted attempting to show how different "mechanisms of disinhibition" affect people's behaviour. "Mechanisms of inhibition" are the ways in which people stop themselves from doing things they don't want to do. Whereas, "mechanisms of disinhibition" are ways that people have trouble stopping themselves from doing things that they shouldn't do. The purpose of the present study is to look at what other personality characteristics may influence these two mechanisms.

2. Procedures. For the purpose of this study I will be asked to complete a number of questionnaires pertaining to motivation, personality and other behaviours.

3. Risks. I understand that there are no significant physical risks or likelihood of psychological injury as a result of reading these lists and giving my ratings. A few of the responses may cause temporary embarrassment or may remind me of acts or situations in my personal life I would rather not recall. However, the questionnaires have been filled out without any lasting effects by thousands of people. If, after responding to the items in these questionnaires, you experience any unpleasant emotions and feel the need to talk to someone about these emotions, help can be found at the Student Counselling Centre (2nd floor of the CAW Centre 253-3000 x4616). If you prefer to seek help elsewhere, a list of

resources is available to you through the Student Counselling Centre or through the Psychological Services Centre.

4. Confidentiality. I understand that my ratings will be completely confidential. There will be no recording of my name or any information that identifies me in any way with my responses. The results of the study showing group data may be later published.

5. I understand that the results of the research will be available to me by request from Dr. Hibbard at 285 Chrysler Hall South (x2248). I also understand that Dr. Hibbard will be available to answer questions about this research during normal office hours Mondays, 1p.m. to 3p.m.

6. I understand that my participation in the process is completely voluntary and that I will be able to withdraw at any time from the study without the loss of bonus points.

7. I understand that the data collected in this study may be used to test subsequent research questions that may be either developed from the results of the current study or related studies. In such cases, the identity of each participant will remain completely confidential.

8. I understand that this study has been reviewed and received ethics clearance through the University of Windsor Research Ethics Board. If you have questions regarding your rights as a research subject, contact:

Research Ethics Coordinator Telephone: 519-253-3000, # 3916
University of Windsor E-mail: ethics@uwindsor.ca
Windsor, Ontario
N9B 3P4

Click here to indicate that you voluntarily consent to participate in the research project.

Appendix L: Debriefing letter sent to studentpParticipants after completion of study

Subject line: Thank you for participating, here is some information about our study

Dear Participant Pool Student,

Thank you for participating in our research study. The purpose of this study was to test a few different research hypotheses. One of these centred on personality traits known as disinhibition mechanisms and other factors that may lead to the encouragement of gambling behaviours (i.e., why people like to gamble) and gambling problems. You were selected to participate in this study simply because you indicated when you enrolled in the participant pool that you have gambled in the past.

A second research hypothesis that will be tested using the data gathered in this study is to look at the influence of biological sex and gender identity and how these influence the development of personality and personality problems.

If you have any additional questions about this study, feel free to contact us via email and we will try to answer them as best we can.

Thanks,

Kristin Stevens, B.A. and Michelle Carroll, M.A.

Clinical Psychology Graduate Students
Department of Psychology
University of Windsor

VITA AUCTORIS

Michelle-Renée Carroll was born in 1976 in Toronto, Ontario. She obtained a Hons. B.Sc. in Psychology at the University of Toronto in 2000. She then obtained her Master's Degree at the University of Windsor in Clinical Psychology in 2002. She will graduate with her Ph.D. in the Fall of 2006 from the University of Windsor.