The relationship between psychopathy and performance on a modified version of the Iowa Gambling Task in offender and undergraduate student samples

by

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Abstract

Given the behavioural similarities between individuals with prefrontal cortex damage and psychopaths, it has been suggested that psychopathy is associated with deficient frontal lobe function (Bechara, 1994; Mitchell, Colledge, Leonard, & Blair, 2002). Previous research regarding the relationship between Iowa Gambling Task (IGT) performance, thought to index prefrontal cortex processing, and psychopathy is mixed, with some studies demonstrating deficient performance on the IGT by psychopathic groups (Blair, Colledge, & Mitchell, 2001; Mahmut, Homewood, & Stevenson, 2008; Mitchell et al., 2002; Morgan, Gray, & Snowden, 2011; van Honk et al., 2002), and others failing to find this relationship (Blair & Cipolotti, 2000; Lösel & Schmucker, 2004; Schmitt, Brinkley, & Newman, 1999). The current study examined the relationship between psychopathy and performance on a modified version of the IGT in a sample of 76 undergraduate students (Study 1) and a sample of 72 incarcerated offenders (Study 2). The modified version of the IGT included a shift in deck contingencies half way through the task. Undergraduate students were assessed using the Psychopathy Checklist: Screening Version (Hart, Cox, & Hare, 1995); offenders were assessed using the Psychopathy Checklist-Revised (PCL-R; Hare, 2006). Heart Rate (HR) and Skin Conductance Response (SCR) were measured indexing physiological responses when making deck selections (anticipatory responses) and to selection outcomes (appraisal responses). Task performance was measured in terms of the overall number of advantageous (lower short-term gain, long-term gain) versus disadvantageous selections (higher short-term gain, long-term loss). In undergraduate students, psychopathy was not found to predict poor performance in the modified IGT. Anticipatory and appraisal SCR and HR physiological responses did not vary as a function of psychopathy in undergraduate students. Psychopathy was found to have an effect on task performance in offenders. Significant

correlations were found been PCL-R Facet scores and HR and SCR responses to deck selections. Differences in findings between Study 1 and Study 2 may suggest a fundamental difference in the impact of psychopathic traits on decision-making between offender and undergraduate samples.

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Introduction

Over the last half-century, psychopaths, and the interpersonal, physical, and emotional damage they wreak on victims, have been the subject of an increasing amount of multi-disciplinary scientific research (Hare, 2006). Psychopathic offenders pose a significant challenge, as they present a higher risk of recidivism than non-psychopaths (Hemphill, Hare, & Wong, 1998; Leistico, Salekin, Decoster, & Rogers, 2008), and have been found to be either unresponsive (Hare, Clark, Grann, & Thornton, 2000; Rice, Harris, & Cormier, 1992; Seto & Barbaree, 1999) or moderately responsive to treatment (Olver & Wong, 2009). Non-criminal or "successful" psychopaths manipulate, deceive, and later discard victims with seemingly no regard for others' feelings, or the social impact of their behaviour (Babiak & Hare, 2006; Cleckley, 1976). While there are those that suggest psychopathy reflects an advantageous adaptive strategy (Barr & Quinsey, 2004; Glenn, Kurzban, & Raine, 2011), it is widely accepted that psychopathy reflects a disorder associated with impaired emotion (Patrick, 1994), information processing (Newman, 1997), or some combination of the two (Mitchell et al., 2002; Newman & Lorenz, 2009; Sommer, Hajak, Döhnel, Schwerdtner, Meinhardt, & Müller, 2006).

Unlike many forms of psychopathology, psychopathic individuals at initial contact appear cogent, displaying few signs of disordered thinking or lack of behavioural control. Only with a broader view of their social behaviour, and enhanced scrutiny of their discourse, are psychopaths revealed to be far from healthy, and predisposed to ignoring negative consequences of their actions, including the emotional reactions of others (Blair, 2005; Cleckley, 1976; Hare, 2006).

This dissertation aims to examine the relationship between psychopathy and social decision-making. This will be accomplished through two studies, one conducted in an undergraduate student (non-criminal) sample (Study 1), one in an offender sample (Study 2).

Prior to discussing the details of the two studies, the following introduction summarizes relevant research findings and methodological issues in four parts: (1) conceptualization and assessment of psychopathy, (2) laboratory evidence surrounding the relationship between frontal lobe function and psychopathy, (3) the somatic marker hypothesis, and (4) the application of the somatic marker hypothesis to psychopathy.

Conceptualization of the Psychopathy Construct

History

Psychopathy as a disorder has been observed in clinical settings since the nineteenth century. One of the first clinical labels for what is now understood as psychopathy was put forward by the French psychiatrist Philippe Pinel (1745/1826), who coined the term *"manie sans delire"* (insanity without delirium) (Millon et al., 1995). Pinel applied this term to individuals who appeared rational and coherent yet at the same time behaved irrationally and often maliciously (Millon et al., 1995).

Extending the work of Pinel, Prichard (1835, cited in Henderson, 1939) used the phrase "moral insanity" to describe those individuals whose framework of moral beliefs and activities were so malformed that they could not effectively navigate themselves in society. Following Prichard, Kock, in 1888, at least partially in response to negative reactions to the term "moral insanity", coined the term "psychopathic inferiority" to describe those who were neither ill nor in full possession of psychic normality and behavioural control (Millon et al., 1995).

PSYCHOPATHY AND MODIFIED IGT

In 1932 the American Psychiatric Association (APA) in a trial version of the nomenclature to be included in the first edition of the Diagnostic and Statistical Manual (DSM-1; APA, 1952), employed the term psychopathic personality. The asocial, amoral, subtype of the description most closely resembles the contemporary concept of psychopathy. In the first edition of the Diagnostic and Statistical Manual (APA, 1952), the term Sociopathic Personality Disturbance (antisocial reaction or sociopath) was ultimately adopted. The second edition of DSM (APA, 1968) changed the name to antisocial personality disorder (ASPD) which has remained intact through DSM-III (1980), DSM-IIIR (1987), and DSM-IV (1994).

ASPD is a condition characterized by a chronic history of irresponsible and illegal behaviour (e.g., stealing, vandalism, assault). ASPD and psychopathy exhibit overlapping symptoms (Hare, 1991; Hare, Hart, & Harpur, 1991). However, ASPD is primarily operationalized in terms of antisocial behaviour, whereas psychopathy is typically discussed in terms of personality traits such as callousness, a lack of guilt, and a propensity to be manipulative towards others (Cleckley, 1976; Hare, 1991). Thus, the two personality disorders may overlap, but are distinct, with the hallmark of psychopathy being a lack of emotional engagement towards others, in addition to antisocial behaviour.

The current conceptualisation of psychopathy as a clinical entity has been greatly influenced by the work of Hervey Cleckley. Cleckley, an American psychiatrist, wrote the book "The Mask of Sanity", based on his experiences with psychopaths in his clinical practice (1976). Cleckley provided a case by case sketch of the prototypical psychopath. Case studies and clinical descriptions in his book describe individuals from varying backgrounds and occupations (Cleckley, 1976). The picture Cleckley (1976) develops of the prototypical psychopath is an individual who may behave rationally one moment, and then be caught performing a poorly

considered crime at a whim, seemingly unaffected by fear of consequences (Cleckley, 1976). Cleckley (1976) provides clinical descriptions of the interpersonal, affective, and behavioural characteristics of a prototypical psychopath including: a tendency to be manipulative, superficial charm, above-average intelligence, absence of psychotic symptoms, an absence of anxiety, lack of remorse, failure to learn from experience, egocentricity, and an almost total lack of emotional depth. Cleckley (1976) also listed more concrete behavioural characteristics including: a trivial sex life, a tendency to be unreliable, an inability to follow a life plan, dishonesty, suicide attempts that were rarely genuine, impulsiveness, and general antisocial behaviour.

The assessment of psychopathy, and research into the potential deficits underlying the disorder, have made tremendous progress over the last 30 years. A key contribution to this progress has been the development of an accepted clinical definition, and associated set of measurement tools for psychopathy, as defined by Hare and colleagues (2006). The wide-spread adoption of Hare's operationalized definition of early clinical descriptions of psychopathy, in particular that of Cleckley (1976), has contributed to the accumulation of scientific knowledge regarding psychopathy.

Assessment of Psychopathy

Hare and colleagues have developed a family of instruments in which raters make inferences from interviews and file material to assess psychopathy including the Psychopathy Checklist Revised (PCL-R; Hare, 1991, 2003), the Psychopathy Checklist: Screening Version (PCL:SV; Hart, Cox, & Hare, 1995), and the Psychopathy Checklist : Youth Version (PCL:YV; Forth, Kosson, & Hare, 2003).

Of the PCL instruments, the PCL-R is the most commonly used forensic assessment tool for psychopathy (Archer, Buffington-Vollum, Vauter Stredny, & Handel, 2006) and has been

referred to as the gold standard for the measurement of psychopathy (Fulero, 1995; Vitacco, Neumann, & Jackson, 2005).

Structure of the PCL-R

Several factor models of the PCL scales have been proposed. Early factor analysis of the PCL-R consistently indicated it loaded on two factors (Harpur, Hare, & Hakstian, 1989). Factor 1 represents the interpersonal and affective psychopathic traits. Factor 2 represents the chronic antisocial, unstable lifestyle features of psychopathy. Items that did not load on either factor include promiscuous sexual behaviour, many short-term marital relationships, and criminal versatility (Harpur, Hare, & Hakstian, 1989). There is a considerable amount of research investigating the correlates of the two factors (Hare, 2003; Hare & Neumann, 2008).

Cooke and Michie (2001) later challenged the two-factor model, and asserted the appropriateness of a three-factor hierarchical model. Cooke and Michie (2001) conducted a series of studies to first determine whether or not the two-factor model was adequate to understand the construct of psychopathy, and later to isolate and validate a three-factor model. The authors found that that the two-factor model was not adequate, and isolated the following three factors of: arrogant and deceitful interpersonal style, deficient affective experience, and impulsive and irresponsible behavioural style. Seven of the items did not load on these three factors, and instead were placed under one unitary construct referred to as "antisocial behaviour", seen as manifestations of the three core factors (Cooke & Michie, 2001). Overall, a three-factor model of psychopathy as a coherent construct, with more emphasis on personality than behaviour (Cooke & Michie, 2001), was supported. Some researchers (Hare & Neumann, 2010; Vitacco, Neumann, & Jackson, 2005) have raised questions about the methods used by

Cooke and Michie (2001) for selecting the 13 items and the criteria used to exclude the so-called antisocial items (see Skeem & Cooke, 2010).

Recent evidence supports a four-facet model (Hare, 2003; Hare & Neuman, 2006; Neumann, Hare, & Newman, 2007). Hare and colleagues have proposed four correlated dimensions that represent the factor structure of the PCL-R: interpersonal, affective, lifestyle, and antisocial. These facets were derived from exploratory and confirmatory factor analysis (CFA) conducted on a large sample comprising male offenders, female offenders, file reviews, and male forensic psychiatric patients. Principal components analyses were conducted on half of the largest of the subsamples, the male offenders, and several models were suggested for later testing using CFA. In all of the principal components analyses, Item 11 (Promiscuous Sexual Behaviour), and Item 17 (Many Short Term Marital Relationships), did not load on a specific factor. Several CFA studies with adult samples have found strong support for the four facet model using the PCL-R (Neumann, Vitacco, et al., 2005; Vitacco et al., 2005). A recent CFA study confirmed the four-facet model in a sample of North American and German offenders with PCL-R scores obtained solely from file review information (Mokros, Neumann, Stadtland, Osterheidera, Nedopilc, & Hare, 2011).

Hare (2003) stresses in the PCL-R manual that a two-factor, four-facet model maximizes the usage of items, and also includes the above described model found by Cooke and Michie (2001), without losing any important information.

A number of studies have demonstrated acceptable fit in adult males for both the three- (Cooke & Michie, 2001; Cooke, Michie, Hart, & Clark, 2005) and four-facet PCL models of psychopathy (Hare, 2003; Neumann, 2007; Neumann, Hare et al., 2007)

The major difference between the three-factor model, and the two- and four- factor models (Hare, 1991; 2003) is the absence of four PCL-R items that "reference criminal behaviour" (Skeem & Cooke, 2010, p. 434). Skeem and Cooke (2010) argue that the three-factor model relative to the two- and four- factor models focuses more on personality pathology than criminal behaviour. Further, the authors suggest that the over-reliance on the PCL-R, developed in samples of incarcerated offenders, has led to a confusion between the measure and the construct, departed from Cleckley's (1976) clinical conception of psychopathy, and has demonstrated a lack of innovation and refinement over the last 20 years.

In reply, Hare and Neumann (2010) have pointed out that Cooke and Michie's (2001) three-factor model also reflects some degree of antisocial behaviour, that Cleckley's observations are not the only attempt at categorizing and understanding the construct of psychopathy, and that the recommended cutoff of a total on the PCL-R of 30 (if scored correctly) can be achieved in non-criminal samples (as the emphasis is on antisocial rather than criminal behaviour). Skeem and Cooke (2010) published a further reply to Hare and Neumann (2010) stressing the need to revisit the measurement of the construct, as factor analytic studies do not advance understanding the construct of psychopathy. Skeem and Cooke's (2010) reply to Hare and Neumann (2010) has not been responded to directly by Hare and colleagues. Regardless, it is clear that a) the PCL instruments have contributed greatly to a large body of replicable and meaningful findings with respect to psychopathy, and b) that contrary to Skeem and Cooke's (2010) position that psychopathy is being confused with the PCL instruments, there is a growing body of multitrait, mutlimethod research being conducted on psychopathy including self-report measures and omnibus personality inventories (for examples see Lilienfeld & Fowler, 2006; Livesley, 2007; Lynam & Widiger, 2007). Table 1 displays a summary of two,- three-, and four-factor models of

the PCL-R.

Table 1

PCL-R Items, Organized According to Two, Three, and Four Factor/Facet Models

Two Factor Model	Three Factor Model	Four Facet Model
Factor 1: Selfish, Callous, and Remorseless Use of Others	*Factor 1: Arrogant and Deceitful Interpersonal Style*	*Facet 1: Interpersonal*
1.Glibness/Superficial Charm	1.Glibness/Superficial Charm	1.Glibness/Superficial Charm
2.Grandiose Sense of Self Worth	2.Grandiose Sense of Self Worth	2.Grandiose Sense of Self Worth
4.Pathological Lying	4.Pathological Lying	4.Pathological Lying
5.Conning/Manipulative	5.Conning/Manipulative	5.Conning/Manipulative
6.Lack of Remorse or Guilt	*Factor 2: Deficient Affective Experience*	*Facet 2: Affective*
7.Shallow Affect	6.Lacks of Remorse or Guilt	6.Lack of Remorse or Guilt
8.Callous / Lack of empathy	7.Shallow Affect	7.Shallow Affect
16.Failure to Accept Responsibility	8.Callous / Lack of Empathy	8.Callous/Lack of Empathy
Factor 2: Chronically Unstable, Antisocial, and Socially Deviant Lifestyle	16.Failure to Accept Responsibility	16.Failure to Accept Responsibility
3.Need for Stimulation / Proneness to Boredom	*Factor 3: Impulsive and Irresponsibly Behavioural Style*	*Facet 3: Lifestyle*
9.Parasitic Lifestyle	3.Need for Stimulation / Proneness to Boredom	3.Need for Stimulation/ Proneness to Boredom
10.Poor Behavioural Controls	9.Parasitic Lifestyle	9.Parasitic Lifestyle
12.Early Behaviour Problems	13.Lack of Realistic Long-Term Goals	13.Lack of Realistic Long-Term Goals
13.Lack of Realistic Long-Term Goals	14.Impulsivity	14.Impulsivity
14.Impulsivity	15.Irresponsibility	15.Irresponsibility
15.Irresponsibility		*Facet 4: Antisocial*
18.Juvenile Delinquency		10.Poor Behavioural Controls
19.Revocation of Conditional Release		12.Early Behavioural Problems
		18.Juvenile Delinquency
		19.Revocation of Conditional Release
		20.Criminal Versatility

Psychopathy Checklist: Screening Version

Administration of the PCL-R requires access to detailed interview and case history information, including official criminal records (Hare, 1991; 2003). Given the information required to properly score the PCL-R, this measure may be seen to be less appropriate for use in non-institutional settings. The Psychopathy Checklist: Screening Version (PCL:SV; Hart et al., 1995) is an adaptation of the PCL-R which, though it also involves a semi-structured interview and collateral information, the collateral information need not require formal institutional records.

The PCL:SV is a 12-item rating scale based directly on the PCL-R. Items are scored in a similar fashion to the PCL-R, ranging from 0-2, summing to a total score of up to 24. Most items on the PCL:SV were taken directly from the PCL-R, only shortened and made more simple, but maintaining true to the traits underlying the original PCL-R items. Other PCL:SV items were created by collapsing, and shortening, two PCL-R items similar in content. For example, item 5 of the PCL:SV - Lacks Empathy, was derived from collapsing PCL-R items 7 (Shallow Affect) and 8 (Callous/Lack of Empathy).

Research supports this instrument as a reliable and valid alternative for assessing psychopathy in a variety of samples, including forensic/nonpsychiatric, forensic/psychiatric, civil/psychiatric, civil/nonpsychiatric (Hart et al., 1995), and students (Forth et al., 1996). Several studies support the concurrent and predictive validity of the PCL:SV (Gray et al., 2004; Nicholls, Ogloff, & Douglas, 2004; Richards, Casey, Lucente, & Kafami, 2003) including a recent study that found the PCL:SV to predict suicidal behaviour and self-harm in a sample of parolees, probationers, and offenders on work release (Gunter, Chibnail, Antoniak, Philibert, & Hollenbeck, 2011).

Factor analytic and item response theory (IRT) analyses have demonstrated that a three- or four-facet model fit the PCL:SV (Cooke et al., 2009; Hill, Neumann, & Rogers, 2004; Vitacco, Neumann, & Jackson, 2005).

Cooke et al. (1999), conducted item response theory analyses on the PCL:SV using the original development sample, in order to determine whether or not the PCL:SV was measuring the same construct as the PCL-R. Comparisons of the PCL:SV and the PCL:R indicated that eight of the 12 items in the PCL:SV strongly paralleled the equivalent PCL-R items. Of the four items that differed, they were all found to be equal or superior to equivalent PCL-R items in terms of discrimination. Also, it was found that Factor 1 items – Interpersonal and affective features of psychopathy, had higher thresholds than the Factor 2 – Antisocial behavioural features. Higher thresholds in this case means that individuals had to be at a higher level of Factor 1 items, such as glibness, before interpersonal and affective traits became evident. Nevertheless, both factors were equally discriminating.

Hart et al. (1995) found, using CFA on the development sample, that the two- factor model was a significantly better fit to their data than a unidimensional model. A later study conducted by Skeem et al. (2003), conducted exploratory and confirmatory factor analyses of PCL:SV scores in a sample of civil psychiatric patients. While initial exploratory factor analyses of the data yielded support for the two-factor model, the researchers, after testing a number of models with CFA, found that Cooke and Michie's (2001) three factor model of psychopathy was more plausible than the traditional two factor model. According to the researchers the three factor model better described the structure of the PCL:SV and also better assessed personality deviation, meaning that it better reflected the underlying personality traits associated with psychopathy, de-emphasizing the behaviour that could be caused by factors other than

personality pathology (Skeem et al., 2003). A recent study by Shariat et al. (2010) conducted CFA and IRT analysis of the PCL:SV in a sample of 351 incarcerated male Iranian offenders, and 405 male offenders from the PCL:SV standardization sample. The Iranian data fitted well with the three factor model of psychopathy, neither two, nor four, factor models showed adequate fit. Of the three factors (of the three factor model) the authors found that the discriminatory power of the second factor, "deficient emotional experience" was greatest.

Hill, Neumann, and Rogers (2004), conducted CFA of the two, three, and four factor models of the PCL:SV using data from inpatients within a maximum security psychiatric facility. In this sample, 68% had a psychotic disorder and 30% met criteria for psychopathy. Results indicated good fit for each model, with the four-factor model showing best overall fit. Babiak et al. (2010) found in a study of 203 corporate professionals (78% male, 22% female) good fit of the four-factor model to PCL-R and PCL:SV "equivalent" scores using CFA and structural equation modelling.

The correspondence between the PCL:SV and PCL-R was recently examined in forensic and correctional samples (Guy & Douglas, 2006). Intermeasure correlations for Total scores and the original two factors, Cooke and Michie's (2001) three factors, and Hare's (2003) four factors were high. Area under the curve values for the PCL:SV were .98 in both samples. The PCL:SV performed well as a screen. Similar correlations for prediction of violent recidivism in the correctional sample were obtained for the PCL-R (r = .42) and PCL:SV (r = .37). Results indicated a robust relationship between PCL-R and PCL:SV Total scores with correlations of r = .95 in forensic samples, and r = .94 in correctional samples. Correlations between Facets 1–4 on the PCL–R with Facet scores of the PCL:SV were also significant, ranging from r = .87 to .92

(forensic samples) and r = .88 to .95 (correctional samples) (Guy & Douglas, 2006). Table 2 displays the two-, three-, and four-factor models of the PCL:SV.

Table 2

Psychopathy Checklist: Screening Version Items Organized According to Two, Three, and Four Factor Models

Two Factor Model	Three Factor Model	Four Factor Model
Factor 1: Interpersonal / Affective	*Factor 1: Arrogant / Deceitful*	*Factor 1: Interpersonal*
1. Superficial	1. Superficial	1. Superficial
2. Grandiose	2. Grandiose	2. Grandiose
3. Deceitful	3. Deceitful	3. Deceitful
4. Lacks Remorse	*Factor 2: Affective*	*Factor 2: Affective*
5. Lacks Empathy	4. Lacks Remorse	4. Lacks Remorse
6. Does Not Accept Responsibility	5. Lacks Empathy	5. Lacks Empathy
Factor 2: Antisocial	6. Does Not Accept Responsibility	6. Does Not Accept Responsibility
7. Impulsive	*Factor 3: Lifestyle*	*Factor 3: Lifestyle*
8. Poor Behavioural Controls	7. Impulsive	7. Impulsive
9. Lacks Goals	9. Lacks Goals	9. Lacks Goals
10. Irresponsible	10. Irresponsible	10. Irresponsible
11. Adolescent Antisocial		*Factor 4: Antisocial*
12. Adult Antisocial		8. Poor behavioural controls
		11. Adolescent Antisocial
		12. Adult Antisocial

Further research will be required in order to establish which of these, or some other, factor structures most effectively accounts for laboratory evidence. However, at the present time the consistent use and findings associated with the four-factor/facet model speak to continuing its application with both the PCL-R and PCL:SV.

Psychopathy as a Taxon or Dimensional Construct

Psychopathy, like many personality disorders may be seen as both taxonomic and dimensional in nature (Clark, 2007). Taxonomic research conducted by Harris, Rice, and Quinsey (1994), using a method described by Meehl and Golden (1982) supported the validity of the PCL-R as an indicator of a taxon underlying psychopathy. Harris et al. (1994) conducted their research on 653 mentally disordered offenders housed in secure Canadian psychiatric institutions. Factor two items (unstable lifestyle and antisocial behaviour), along with a number of variables having to do with childhood history in particular were consistent with a taxonomic perspective. Items associated with Factor one (affective and interpersonal) were not found to be consistent with a taxonomic structure.

This study has been criticised on the basis of the potential for the identified taxon being related to schizotypy, and the authors' approach to scoring the PCL-R using only file review information and dichotomizing items (Edens, Marcus, Lilienfeld, & Poythress, 2006; Guay, Ruscio, Knight, & Hare, 2007). This study has also been criticized based on the statistical procedures used in the study (Guay, et al., 2007).

Skilling, Harris, Rice, and Quinsey (2002) reanalyzed the date from Harris et al. (1994) to investigate the taxometric structure of Antisocial Personality Disorder (ASPD), the PCL-R, and the Child and Adolescent Taxon Scale (CATS). The authors found taxonic evidence for ASPD

and CATS, but not for psychopathy. The same criticisms levied towards the Harris and colleagues (1994) study also apply to the study by Skilling and colleagues (2002).

Edens and colleagues (2006) examined the latent structure of psychopathy using a number of statistical approaches to taxometric analysis, scored the PCL-R using interview and file information, and did so in a sample of 876 male incarcerated offenders and offenders sentenced to court-ordered residential drug treatment programs. The authors found no compelling support for a latent taxon underlying psychopathy. While not specific to psychopathy, using these same taxometric procedures to investigate the latent structure of ASPD in a group of 1,146 prison inmates and noninsitutionalized substance abuse patients that overlapped substantially with the sample employed by Edens and colleagues (2006), Marcus, Lilienfeld, Edens, and Poythress (2006) found evidence of dimensionality with ASPD.

Guay and colleagues (2007) conducted a study with a sample of 5,408 male prison inmates assessed on psychopathy using both file and interview information. The sample had a 19% base rate for psychopathy. The authors also addressed shortcomings of previous studies by not dichotomizing PCL-R items, and improving on the statistical techniques used in the analysis. The sample was further broken down by security level and ethnic status, and the four-factor model of the PCL-R (Hare, 2003) was the primary point of analysis for the study. The authors found support for a dimensional view of psychopathy as a whole and for the four factors. In discussion their results, the authors raise the possibility that their findings do not preclude other measures uncovering a taxon in psychopathy. The authors conclude with the statement that researchers should "not yet forego the more traditional group comparison approaches, such data should be analyzed and interpreted with dimensional precautions in mind" (Guay et al., 2007, p. 713).

Walters, Duncan, and Mitchell-Perez (2007) sought to confirm that the latent structure of the PCL-R conforms more closely to a dimensional structure than a categorical (taxonic) model. Walters and colleagues (2007) sample differed from previous studies in that it included three male incarcerated samples of 265 multi-level security inmates, 62 maximum security inmates, and 82 minimum security inmates. There was a 28.8% base-rate of psychopathy in the overall sample based on a cutoff of 30 on the PCL-R. Their sample also yielded a significantly greater dispersion of PCL-R scores, or heterogeneity in their overall sample relative to previous studies (Edens et al., 2006; Guay et al., 2007). The authors found support for a dimension interpretation of psychopathy using the PCL-R, and concluded that high and low scores on the PCL-R reflect quantitative differences in degree rather than categorical qualitative differences.

In a sample of male and female forensic/psychiatric patients and jail/prison inmates Walters et al. (2007) found evidence for a dimensional structure on the PCL:SV in the sample as a whole and in subsamples based on gender, race, and institutional milieu. The authors concluded that scores on the PCL:SV differ dimensionally rather than according to distinct categories.

The balance of the research suggests that psychopathy as assessed using the PCL-R or PCL:SV may treat the measure as both a taxon and a dimensional construct. In addition to the PCL-R and PCL:SV, support for a dimensional view has been well established with self-report scales of psychopathy in criminal and non-criminal samples (Benning, Patrick, Salekin, & Leistico, 2005; Brook, Kosson, Knight, & Sims-Knight, 2003; Marcus, John, & Edens, 2004; Walsh & Robins, 2005).

Self-Report Measures of Psychopathy

Self-report measures of psychopathy have a number of advantages over the standard clinical assessment of psychopathy using the PCL-R (Lilienfeld & Fowler, 2006). Self-report instruments offer the opportunity for directly measuring a participant's subjective emotional experiences and attitudes. These instruments are also easier to score, are often brief, and do not require access to corroborating information. Self-report instruments also pose no challenge in terms of inter-rater reliability.

However, despite these advantages, they are limited in terms of their reliance on insight. Cleckley (1976) noted that psychopaths "lack insight more consistently than some schizophrenic patients" (p. 350). Also, given one of the hallmarks of the disorder is to lie and otherwise manipulate others, psychopaths may dissimulate when responding to self-report questions. Indeed, given that psychopaths are thought to experience an affective deficit they may not fully grasp the affective meaning of many questions.

Despite the potential shortcomings of self-report measures of psychopathy over the last twenty years a number of investigators have developed promising instruments that appear to demonstrate favourable psychometric properties. Among these are the Psychopathy Personality Inventory (PPI; Lilienfeld, 1990) and the Self-Report Psychopathy scale (SRP; Hare, 1985). The PPI was designed to measure psychopathy in noncriminal samples such as students. It consists of 187 items in a Likert format. The PPI has eight subscales to measure lower-order facets of psychopathy and also contains validity scales to detect positive impression management styles, malingering, and careless or random responding. The eight factors include: Machiavellian egocentricity, social potency, fearlessness, coldheartedness, impulsive nonconformity, blame externalization, carefree nonplanfulness, and stress immunity. Benning, Patrick, Hicks, Blonigen,

and Krueger (2003) using a community sample revealed that the subscales of the PPI coalesce around two orthogonal higher order factors: PPI-I, labeled Fearless Dominance (includes social Potency, fearlessness, and stress immunity subscales of the PPI) and PPI-II, termed Impulsive Antisociality (includes carefree nonplanfulness, impulsive nonconformity, machiavellian egocentricity, and blame externalization of the PPI.

In undergraduate samples, the PPI has been found to have Cronbach's alphas from .90 to .93, with subscales ranging from .70 to .90 (Lilienfeld & Andrews, 1996). Test-retest reliabilities were also high with $r = .95$ over a mean 26-day interval, and $r = .82$ to .94 for subscales (Chapman, Gremore, & Farmer, 2003). The scale has also demonstrated convergent and discriminant validity with other self-report measures of psychopathy (Lilienfeld & Fowler, 2006).

The SRP is currently in its third version. The SRP-III (Paulhus, Neumann, & Hare, in press) is a 40-item self-report questionnaire designed to be a measure of sub-clinical psychopathy. Participants respond to Likert-type questions. In undergraduate students the SRP-III has been reported to have good psychometric properties (Paulhus & Williams, 2002). Cronbach's alpha for the SRP-III has been reported as .79, and to correlate significantly with the Narcissistic Personality Inventory (NPI; Raskin & Hall, 1979) and the MACH-IV (Christie & Geis, 1970) measure of Machiavellianism (see also Zagon & Jackson, 1994). The SRP-III yields a total score as well as scores on four subscales: Callous Affect, Criminal Tendencies, Erratic Lifestyle, and Interpersonal Manipulation. These subscales have recently been confirmed using CFA (Seibert, Miller, Few, Zeichner, & Lynam, 2011).

A growing body of self-report measures for psychopathy are emerging with impressive psychometric properties. These measures also yield similar factor structures as the PCL-R and

PCL:SV. Given the ease of administration, self-report psychopathy scales, though potentially subject to dissimulation on behalf of psychopaths, are making an impressive contribution to the field of psychopathy and lend themselves well to research in non-institutional samples.

Primary and Secondary Psychopathy

Originating in the clinical work of Karpman (1941) theorists have suggested that there are two subtypes of psychopathy that present similarly, but may be traced to different etiological causes. Karpman (1941) described psychopaths as manipulating others and often manifesting antisocial behaviour. The primary psychopath displays a constitutional affective deficit, whereas secondary psychopaths display an affective disturbance based on early social learning. Aggression and anger displayed by the secondary psychopath are directly related to earlier childhood experiences of abuse and parental rejection. Primary psychopaths were thought by Karpman to display only lower-order instinctive emotional organization similar to a nonhuman animal. The secondary psychopath was thought capable of empathy or other higher-order emotions. Secondary psychopaths also often suffer from an underlying anxiety, depression, or character neurosis.

Karpman's subtypes were further developed and expanded by the work of Lykken (1995). Lykken linked notional primary and secondary psychopathy subtypes to Gray's Behavioural Inhibition System (BIS) and Behavioural Activation System (BAS) models (Gray & McNaughton, 1996). Unlike healthy controls, the primary psychopath generally fails to display anticipatory anxiety in the face of impending aversive consequences; reflecting an underactive BIS (Fowles, 1990). Secondary psychopaths possess overactive BAS and are likely to display poor passive avoidance in the face of rewards strong enough to overcome fear of consequences (Lykken, 1995). For Lykken primary and secondary psychopaths are both extreme temperaments

associated with constitutional abnormalities, as BIS and BAS are both associated with lower-level biological responses - aversive and appetitive respectively.

Porter (1996), in keeping with Karpman, suggested that primary psychopathy reflects an inherited affective deficit. This in contrast to the acquired nature of secondary psychopathy. For Porter, secondary psychopathy is best described as dissociative rather than neurotic. Secondary psychopathy may stem from specific environmental insults such as physical or sexual abuse or abandonment. The resulting disillusionment interferes with the formation of important interpersonal relationships based on love or other positive affect. Secondary psychopaths dissociate to "deactivate" their emotional responses, acquiring the features of psychopathy related to shallow affect.

Researchers have also sought to differentiate between primary and secondary psychopaths based on levels of trait anxiety (Arnett, Smith, & Newman, 1997; Brinkley, Newman, Widiger, & Lynam, 2004; Hiatt, Schmitt, & Newman, 2004). From this perspective low-anxious psychopaths may be considered to be primary psychopaths, and high-anxious psychopaths may be seen as secondary psychopaths.

Taken as a whole, it is clear that current debate regarding the assessment of psychopathy speaks to taking into account factors of the PCL-R and PCL:SV, and where possible, both a dimensional and taxonic view of the construct of psychopathy. Further, laboratory studies using these measures should recognize the influence of possible subtypes of the disorder, in particular primary and secondary psychopathy subtypes.

Psychopathy and Frontal Lobe Function

Working Memory, Attention, and Set-Shifting

The frontal lobe is involved in executive functions such as planning, attention, working memory, mental flexibility (set-shifting), problem solving, verbal reasoning, response inhibition, multi-tasking, and initiation and monitoring of actions (Chan, Shum, Toulopoulou, & Chen, 2008).

Based largely on findings from neuroimaging studies with antisocial populations (Goyer & Semple, 1996; Raine, Buchsbaum, Stanley, Lottenberg, Abel, & Stoddard, 1994; Volkow & Tancredi, 1987) Raine (1997) postulated a prefrontal dysfunction theory of antisocial behaviour. According to Raine (1997) damage to the prefrontal cortex within the frontal lobe is the cause of psychophysiological arousal and orienting deficits observed in antisocial populations.

To address a paucity of quantitative reviews on the subject of executive or frontal lobe functioning and antisocial behaviour, Morgan and Lilienfeld (2000) conducted a meta-analysis of 39 studies that included measures of executive dysfunction[1] in antisocial populations. The authors found that antisocial groups performed more poorly than controls. The authors noted that there were potential limitations in analyzing their data based on the instruments used to measure psychopathy and other antisocial disorders, and that they were not able to subdivide the tasks based on specific sub-brain regions. The tests used were not capable of specifically indexing orbitomedial prefrontal function, an area possibly related to psychopathy and other forms of antisocial behaviour (Blumer & Benson, 1975; Damasio et al., 1990). The authors, for example, did not include any studies using the Iowa Gambling Task, an arguably effective index of ventromedial prefrontal cortex function (Bechara, 1994). This may,

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Qualitative (Q) score on the Porteus Mazes Test, the Stroop Interference Test, Part B of the Trail Making Test (TMT), the perseverative error score on the Wisconsin Card Sorting Test (WCST), and Verbal fluency Tests.

according to the authors, have underestimated the medium to large effect size observed in their meta-analysis (antisocial participants scoring .62 standard deviations more poorly than controls). The authors also commented on the limited number of studies available that specifically indexed executive function in studies assessing psychopathy using PCL instruments. Most of the observed effects would be associated with social deviance and criminality, which would more closely relate to PCL-R/PCL:SV Factor 2 (Facets 3 and 4).

Findings have been mixed with respect to standard tests of executive function in psychopathic individuals (Gorenstein, 1982; Hare, 1984; Hart, Forth, & Hare, 1990; Smith, Arnett, & Newman, 1992; Pham, Vanderstukken, Philippot, & Vanderlinden, 2003; Schalling & Rosen, 1968). Some researchers have found evidence of deficient executive function in psychopaths. For example, Schalling and Rosen (1968) found that psychopaths, defined according to Cleckley's (1976) criteria performed poorly on the Porteus Maze Test, which requires tracing a path through a maze printed on a piece of paper, when compared with offenders with low psychopathy ratings. The Porteus Maze is used as a measure of performance intelligence, and scoring includes careless and impulsive errors as well as signs of difficulty in following task instructions.

Gorenstein (1982), in a sample of patients recruited from substance abuse programs and undergraduate student controls, found that psychopathic patients[2] made more errors on the Wisconsin Card Sorting Task (WCST; Milner, 1963) and the Sequential Matching Memory Task (SMMT; Lezak, 1995), and more spontaneous reversals on the Necker cube[3]. These data largely suggested that psychopathy was associated with impairments in frontal lobe functioning including perspective reversal and sequential memory tasks.

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[2] Psychopathy was defined by a combination of ASPD diagnosis, and low scores on the socialization scale of the California Psychological Inventory (Gough, 1960).
[3] The Necker Cube is a visual illusion involving alterations in depth/figure perception.

Hare (1984) challenged this view when he found that incarcerated offenders did not perform poorly on tests of frontal lobe functioning including the WCST, the Necker Cube, and the SMMT. Hare (1984) suggested that differences in findings may have been due to the sample used in Gorenstein's study (1982), given that those classified as psychopaths were likely all high Factor 2 of the PCL-R. In addition, Gorenstein (1982) did not control group comparisons on key demographic and educational variables. Gorenstein (1982) also did not control for substance abuse, which may have contributed to the poor performance of the psychopathic group on measures of frontal lobe function (Hare 1984). Hare (1984) argued that, "there is little support for the position that psychopaths have specific cognitive deficits in the processes associated with frontal lobe functioning" (p. 139). Hart et al. (1990) also found no evidence that psychopathy was associated with a frontal lobe dysfunction in offenders.

In offenders, Smith, Arnett, and Newman (1992) found low-anxious psychopaths performed more poorly than controls on visuospatial, motor, and task-switching tests indicating low-anxious psychopaths have difficulty with the integration of cognitive-perceptual and motor processes. The authors noted that this difference only emerged after diving groups based on trait anxiety. Pham and colleagues (2003) found psychopaths displayed errors on a maze task, as well as on visual scanning, and planning tasks relative to controls. These findings were interpreted as indicating both poor attentional control in the face of distracters and a selective attention deficit.

In a non-criminal sample, Belmore and Quinsey (1994) found that participants with high (compared to low) psychopathy traits with criminal convictions, played significantly more cards on a gambling task in which there was a declining probability of success, suggesting an executive dysfunction. However, because both groups won similar amounts of money, the authors suggested the high psychopathy group might have found the task more rewarding and

employed an adaptive gambling strategy (Belmore & Quinsey, 1994). In another community study, where 11 of 12 participants were classifiable as psychopaths (Dinn & Harris, 2000), no differences between the high psychopathy group and controls were found on the WCST. Ishikawa and colleagues (2001) found that unconvicted psychopaths performed better on the WCST than convicted psychopaths and controls. Coupled with the unconvicted psychopaths' greater psychophysiological arousal, Ishikawa and colleagues (2001) suggested that a superior executive function might serve as a "protective" factor (i.e., avoiding incarceration).

While somewhat equivocal, research suggests psychopathy (and antisociality more broadly) is associated with a frontal lobe deficit. However, one of the reasons why there are conflicting findings in the research may be that the tasks used may index different areas within the frontal lobe.

Orbitofrontal / Ventromedial Prefrontal Cortex

It is well-established that areas of the human prefrontal cortex are involved in distinct cognitive and behavioural processes. Studies observing the behaviour of neurological patients with damage to different areas of the frontal lobe yielded insights into different neuropsychological specializations. This research has supported a functional specialization within the prefrontal cortices. For example, damage to the dorsolateral prefrontal cortex has been linked to deficient motor planning, organization, and regulation (Fuster, 1990; Goldman-Rakic, 1987; Milner et al., 1985; Petrides, 1996). This area has also been found to play an important role in the integration of sensory and mnemonic information and the regulation of intellectual function and action.

Many of the neurological tests discussed such as the SMMT may index dorsolateral prefrontal cortex (DLPFC) function, rather than ventromedial prefrontal cortex function (VMPFC). A study

by Fellows and Farah (2005) provided evidence suggesting reversal deficits in patients with focal VMPFC lesions, but intact reversal performance in patients with focal DLPFC lesions. Support for this finding comes from a study of patients with with frontal variant fronto-temporal dementia (Rahman et al., 1999). These patients typically display behavioural disinhibition, and in this study, participants demonstrated impairments in reversal learning (and decision-making) but intact performance on executive functions associated with the DLPFC.

Damage to the ventromedial sector disrupts social behaviour. Individuals previously capable of functioning within the bounds of social convention are unable to do so, and unable to decide advantageously on matters pertaining to their own lives. Despite these social deficits, the intellectual abilities are generally well preserved. Many patients with damage to the VMPFC have normal learning and memory, language and attention, and they even perform normally on executive function tests, such as the WCST (Damasio et al., 1991; Damasio & Anderson, 1993). These patients have also been found to display deficient emotional response to complex social situations and events such as not reporting feelings of embarrassment ordinarily brought about in specific social contexts (Damasio et al., 1991; Damasio & Anderson, 1993).

LaPierre et al. (1995) administered tests associated with orbitofrontal / ventromedial frontal lobe functions including a Go/No-Go discrimination task, the Porteus Maze Task, and a smell identification task as well as tests associated with frontodorsolateral function indexing perseverative error, and a mental rotation task associated with right posterior cortex function, to incarcerated psychopaths and nonpsychopaths. The authors found psychopaths made more olfactory identification errors, more commission errors on the Go/No-Go task, and more qualitative errors on the Porteus Maze Task (i.e., crossing lines or lifting their pencils). The Go/No-Go task requires participants, after initially forming a prepotent response tendency, to

reverse this response. The psychopathic offenders were significantly more likely than controls to continue to respond to the stimulus. The authors interpreted these findings as consistent with the possibility of orbitofrontal lesions (OFC).

Deficits in response inhibition and executive functioning have also been linked to psychopathy in an undergraduate student sample (Sellbom & Verona, 2007). Sellbom and Verona (2007) found in a sample of 95 (45 female) undergraduate students that PPI total score predicted response inhibition but was not correlated with executive function. The social deviance facet of the PPI predicted poor executive function and response inhibition. The affective/interpersonal facet predicted enhanced executive function. The authors interpreted the interpersonal/affective facet finding as consistent with the view that in non-criminal samples, greater cognitive resources may be related to the social dominance required when navigating complex social situations (Salekin et al., 2004). Poor performance on measures associated with the social deviance facet of the PPI was interpreted as supporting the view that individuals that engage in social deviant/antisocial behaviour have fewer cognitive resources at their disposal.

While initially equivocal, evidence would seem to favour a deficit in the VMPFC in psychopathic offenders. Further, this deficit emerges in both offender and non-offender samples. However, in part due to limitations of the tasks used in studies, the localization of putative frontal lobe deficits is not well established. Research has also suggested that self-report and PCL-R/PCL:SV factors may be differentially related to observed deficits in frontal lobe function.

Avoidance Learning / Fear Conditioning

Many of the earlier laboratory studies of psychopathy focused on fear or avoidance conditioning in psychopaths in a laboratory setting (for reviews see Lykken, 1995; Hare, 1998; Newman, 1998; Newman & Wallace, 1993).

PSYCHOPATHY AND MODIFIED IGT

Skin conductance was often measured as an index of the extent to which psychopaths would experience fear or anxiety when presented with impending, unpleasant consequences (see reviews by Hare, 1978, 1998; Lykken, 1995; Newman & Wallace, 1993). For example, Lykken (1957) conducted a study in which incarcerated psychopaths, nonpsychopaths, and high school student controls were instructed to learn a sequence of lever presses that would navigate them through a "mental maze" task while palmar skin conductance was recorded. Psychopaths were rated as most prototypical of the Cleckley (1976) psychopath by institutional psychologists. The institutional non-psychopaths were considered neurotic psychopaths[4]. Participants also had to learn a task to inhibit pressing specific levers, since these would result in receiving electrical shocks. Psychopaths displayed the poorest passive avoidance learning, or ability to inhibit punished responses, indicating that they were less concerned about the shocks and instead focused their attention on learning the correct levers (Lykken, 1957). The skin conductance response (SCR) of the primary psychopaths was reduced and rapidly extinguished relative to the controls (but not compared to neurotic psychopaths).

A later study by Schmauk (1970) also examined passive avoidance learning in psychopathic and nonpsychopathic offenders using three different types of punishment. These punishments included: saying "wrong", administering electric shocks, or subtracting 25 cents from an eight dollar initial stake. Schmauk (1970) found that psychopaths performed more poorly than nonpsychopaths in the electric shock and verbal reprimand conditions. The groups did not differ when the loss incurred was monetary, indicating to the authors that only salient punishment (i.e., loss of monetary reward) inhibited behavioural responses (Schmauk, 1970).

Hare and Quinn (1971) examined classical conditioning in a sample of psychopathic and nonpsychopathic offenders (as defined by an earlier 7-point clinical rating scale pre-dating the

[4] Neurotic psychopaths may be seen to be very similar to "secondary" psychopaths.

PCL-R). Participants in this study were presented with a series of 10 second long tones either paired or not paired with an aversive stimulus (Hare & Quinn, 1971). Psychopathic offenders showed much lower anticipatory skin conductance to tones followed by an aversive stimulus than nonpsychopathic controls. Both groups did display an orienting response including deceleration in heart rate (HR), indicating an increase in attention in anticipation of aversive stimuli. These results suggest that where punishment or threat is clear and expected, psychopaths display differential skin conductance response (SCR).

A number of studies involving skin conductance and HR conducted by Hare and colleagues isolated a differential orienting response, or tendency for the psychopathic and nonpsychopathic offenders to differ in their physiological processes in anticipation of an unpleasant event (Hare, 1978; Lacey & Lacey, 1970). The experimental paradigm often used in these studies was the "countdown" paradigm, where participants would await an aversive stimulus. In psychopaths, HR would increase, but skin conductance would only increase slightly, whereas in nonpsychopaths, skin conductance would greatly increase with slight increases in HR. The gating response in this case was interpreted as indicating an increase in fear of nonpsychopaths and a capacity for the psychopaths to ignore the impending aversive event (Hare, 1978). This ability to "tune out" cues associated with impending fear or punishment seemed to operate equally well in situations in which the psychopath would administer aversive shocks to others (Hare & Craigen, 1974) and has been replicated more recently by other researchers (Dindo & Fowles, 2010; Ogloff & Wong, 1990). For example, in one of the two tasks employed in Ogloff and Wong (1990), an increase in HR was found in the face of unavoidable punishment cues suggesting tuning out of unavoidable threat. However, across the

two tasks, psychopaths displayed significantly lower HR increase prior to tones indicating avoidable punishment than controls indicating an orienting response.

In other studies, incarcerated psychopaths have been found to exhibit reduced autonomic response during tasks. Hare (1982) found that when psychopaths controlled how they allocated their attention while anticipating punishment (Hare, 1982), they demonstrated lower HR and skin conductance than did nonpsychopaths. Similarly, Arnett and colleagues (1993) found that when psychopaths were punished in the context of pursuing rewards, they also displayed lower HR and skin conductance. Patrick, Cuthbert, and Lang (1994) also found that psychopaths and antisocial prisoners demonstrated less cardiovascular reactivity during a sentence-cued, fear imagery task than did nonpsychopathic prisoners.

In a non-forensic sample, Flor, Birbaumer, Hermann, Ziegler, and Patrick (2002) compared the responses of nine noncriminal psychopaths including chronic traffic violators and three "adventurous types", and 12 healthy controls during an aversive Pavlovian conditioning experiment. In this experiment, a foul odour (conditioned stimulus) was paired with neutral faces (unconditioned stimulus). Dependent variables in this study included skin conductance, event-related brain potentials, HR, corrugator (frown) electromyographic recordings, auditory startle response potentiation (measured through startle-blink), and subjective measures of arousal and valence. Psychopaths in this study exhibited similar electrodermal and heart rate activity as that reported by Hare and Quinn (1971) with little evidence of electrodermal conditioning, but evidence of cardiac deceleration. The psychopathic group also displayed "an emotional associative deficit" (Flor et al., 2002, p.514) evidenced by smaller skin conductance, startle, and corrugator muscle responses than nonpsychopaths. Electroencephalographic recordings reflected

that psychopaths were not deficient in information processing, but displayed deficient aversive emotional conditioning.

A study by Hansen, Johnsen, Thornton, and Thayer (2007) examined the relationship between heart rate indices (resting HR and heart rate variability) and psychopathy in a sample of incarcerated offenders. The researchers, using the PCL-R, presented participants with two cognitive tasks, a continuous performance task (CalCAP) and a working memory test (WMT). Resting HR and heart rate variability were both correlated with PCL-R facet scores. The results suggested that the interpersonal facet (Facet 1) explained most of the variance in heart rate variability and resting heart rate. The antisocial behaviour facet (Facet 4) was related to baseline heart rate variability as expected based on previous findings with respect to resting HR and psychopathy (Raine, 1997). The authors also found that participants differed in task performance as a function of the interpersonal facet (Facet 1). Participants high in Facet 1 made fewer error responses on a working memory task of the CalCAP compared to those with low scores on Facet 1. This was supported by the results on the WMT. That participants high in Facet 1 scored better on cognitive tests is in keeping with previous research in youth (Salekin et al., 2004) and with psychiatric patients (Vitacco et al., 2005).

Verona, Patrick, Curtin, Bradley, and Lang (2004) investigated physiological reactions to emotional sounds in incarcerated offenders selected according to scores on the PCL-R, and analyzed the data by further sub-diving groups based on scores on the original two-factor model. Offenders high on the PCL-R Interpersonal/Affective factor (Factor 1) at either high or low levels on the social deviance factor (Factor 2), showed diminished skin conductance responses to both pleasant and unpleasant sounds. Offenders who scored high only on Factor 2 showed a delay in heart rate differentiation between affective and neutral sounds. These findings suggest

abnormal reactivity to positive and negative emotional stimuli in psychopathic individuals, and differing roles of psychopathy factors when analyzing autonomic responses to emotional stimuli.

In an undergraduate student sample, Dindo and Fowles (2010) analyzed skin conductance responses of male undergraduate students during a speech and a noise anticipation task. The speech task involved speaking to ones' faults and the anticipation task involved waiting through a countdown for a noise-burst. The authors used the Psychopathic Personality Inventory (PPI; Lilienfeld & Andrews, 1996) and the factors identified by Benning et al. (2003). Results of Dindo and Fowles (2010) study using these two factors suggested a relationship between PPI-I and reduced skin conductance response during anticipation of an aversive noise and PPI-II with increased skin conductance reactivity during the speech (suggesting anxious apprehension).

Despite a number of contradictory findings these studies raise the possibility that there may be a substantive difference in psychopath's deficient anticipatory responses between tasks involving avoidable versus unavoidable threat cues. It may be the case that psychopaths are more adept at "gating out" threatening cues in unavoidable circumstances, but do attend to relevant stimuli where punishment can be avoided.

These studies suggest that physiological responses to emotional stimuli vary as a function of psychopathy facet. Specifically, individuals higher on the affective facets/factor of psychopathy consistently display diminished skin conductance response with respect to impending punishment and when exposed to emotional stimuli. Further, facet scores may differentially relate to the physiological responses to task performance and task performance itself. Put differently, where interpersonal/affective facets of the construct may be strongly related to physiological responses to task contingencies, performance on the task may be strongly related to the social deviance/antisocial behaviour facets of psychopathy.

Response Inhibition

The hallmark of the cognitive/affective deficits associated with psychopathy is a deficiency in incorporating punishment, and punishment cues, into reward-seeking behavioural strategies, and to accordingly adjust behavioural responses.

Newman and Kosson (1986) directly tested the extent to which competing reward was central to passive avoidance learning in psychopaths. Newman and Kosson (1986) presented offenders with two versions of a passive avoidance task. One version of the task involved the both reward and punishment feedback (Newman & Kosson, 1986). Feedback consisted of a tone and losing 10 cents if an incorrect response was made and if the response was correct they heard a different tone and earned 10 cents. In the second version, participants lost money if they responded to a punished stimulus or failed to respond to a rewarded stimulus. No feedback was given if they gave a correct response. Psychopaths made more passive avoidance errors than controls in the version involving competing reward and punishment contingencies, but performed comparably to controls in the punishment only condition.

In the same vein, Newman and colleagues (1990), found that in a task where participants were encouraged to obtain rewards, psychopaths displayed poor passive avoidance learning. However, in a task where punishment and reward were made clear and central to task at the outset, the authors observed no significant difference between psychopaths and controls. Further, using subject-terminated response feedback, they found that in the task emphasizing rewards, psychopaths paused less than controls following negative feedback, and the extent to which participants paused following negative feedback was correlated with passive avoidance learning. Newman and colleagues (1990) concluded that it is not the presence of reward alone that reveals

poor passive avoidance learning in psychopaths, but instead, the need to interrupt a primary reward seeking strategy, in order to process and learn from punishment feedback.

A later study by Arnett and colleagues (1997) reinforced the notion that punishment alone is not enough to reveal poor passive avoidance learning in psychopaths. Arnett and colleagues (1997) used a simple stop-signal task where participants were required to respond to targets (by pressing buttons) as quickly as possible, but avoid responding if an inhibitory cue was also present. Psychopaths showed normal behavioural inhibition on this task. Similar effective response inhibition was found in an experiment by Newman, Wallace, Schmitt, and Arnett (1997). Participants were asked to search a letter string and respond to targets unless the letter "Q" also appeared in the letter string. High-anxious psychopaths displayed facilitation, rather than inhibition on this task (Newman et al., 1997).

Adding a measure of cortical activation, Kiehl, Smith, Hare, and Liddle (2000) also found appropriate behavioural inhibition among psychopaths on a Go/No-Go task. The instructions, as in the studies immediately above, were explicit with respect to reward and punishment contingencies from the start of the task. Cortical activation, measured through cortical event related potentials, however, was abnormal in psychopaths, with less differentiation between the go and no-go stimuli at the N275 and reversed differentiation (no-go greater than go) at the P375 component. Based on prior findings, it has been suggested that this finding indicates that, despite the adequate performance, more effortful processing may be required on behalf of psychopaths in the face of such tasks (Hiatt & Newman, 2006).

Building on the earlier passive avoidance findings, Newman and colleagues (1987) demonstrated that forced pauses can remedy psychopaths' poor behavioural inhibition in the presence of attention-drawing reward contingencies. The experimenters presented psychopaths

and controls with three different versions of a card playing task. In each task, the probability of reward declined across trials (at a fixed rate), while the probability of punishment increased (at a fixed rate). To maximize winnings, participants needed to stop playing cards approximately halfway through the 100-trial task. The three task versions differed in the feedback given. In the first version, participants received feedback after each response, but no running tally was provided. In the second version, a cumulative tally was provided, after each response. In the third version, cumulative results were displayed, and participants were forced to pause for five seconds before the start of the next trial. Newman and colleagues (1987) found normal response inhibition among psychopaths only in the third condition, when they were forced to pause for five seconds following feedback.

Psychopaths may have difficulty making associations between punishment and behavioural responses, through a deficit in fear, however the findings can also be explained by an inability to process punishment contingencies. Further, pausing between responses appear to assist psychopaths in attending to consequences and assists them in adjusting behaviour.

Reinforcement Sensitivity Theory

Gray's Reinforcement Sensitivity Theory (RST; Gray, 1981; 1987; Pickering & Gray, 1999) posits two complementary systems, the Behavioural Inhibition System (BIS) and the Behavioural Activation System (BAS). The BIS inhibits goal directed behaviour in the face of threats or inconsistent stimuli in the environment. The BAS underlies an organism's response to reward cues and approach behaviour. As BAS increases, so does the probability of goal directed behaviour. The BIS is largely informed by learned associations between behaviour and past punishment (positive or negative). Fowles (1980) conducted a thorough review of evidence for the physiological relationship between the BIS and HR and electrodermal response of skin

conductance changes. Fowles suggested that HR is strongly associated with activity of the BAS. According to Fowles, this accounted for previous findings with respect to incentive effects on HR, and increased HR in connection with active coping in the face of threat. Skin conductance, on the other hand, increases when there is an activation of the BIS. With this model it is possible to explain autonomic findings within psychopathic samples based on the assumption that primary psychopaths have a normal BAS, but deficient BIS. Primary psychopaths show normal approach, active avoidance, and reduced HR, but they suffer from poor passive avoidance and extinction with reduced SCR in response to threatening stimuli.

Newman, MacCoon, Vaughn, and Sadeh (2005) found strong support for the association of primary psychopathy with a weak BIS and normal BAS, and secondary psychopathy with a strong BAS. The RST model, then, provides good explanatory potential for the disinhibited behaviour psychopathic individuals (Newman & Malterer, 2009).

In a study by Newman, Wallace, Schmitt, and Arnett (1997), incarcerated offenders completed a two-phase task. In the first phase participants performed a Go/No-Go task where they were to respond as quickly as possible to strings of letters unless the letter "Q" also appeared in the letter string. If they responded properly in go trials they were rewarded as a function of speed; if they responded in no-go conditions they were punished. This phase provided the initial conditioning Q as a punishment cue. In the second phase, offenders were rewarded for how quickly they responded to a four-symbol string of characters if they were all letters. Three letters with one number was the no-go condition and they were punished if they responded. In 50% of the trails in phase two (including both go and no-go trials) the letter Q was present. This was intended to activate the BIS and interrupt approach behaviour on go trials. The study found that BIS was inhibited as a function of psychopathy. There was, however, an

interaction between psychopathy and anxiety, such that the effect was specific to psychopathic and non-psychopathic groups high in anxiety with high-anxious psychopaths displaying the weakest inhibition (i.e., secondary psychopaths). These findings ran contrary to what would be expected under the low fear and weak BIS model of primary psychopathy (Baskin-Sommers, Wallace, MacCoon, Curtin, & Newman, 2010).

To attempt to reconcile this apparent contradiction, Baskin-Sommers and colleagues (2010) conducted a study with offenders divided into four group based on high and low psychopathy, and high and low anxiety. Participants completed a task whose primary goal was to search a screen for the presence of a target letter. The set of possible targets was presented below the words "Look for" and they consisted of either two or four letters. Then four letters were presented in the four corners of the screen in some combination of non-target letters and numbers or targets were displayed. Participants were to only respond if one of the targets appeared in the upper right or bottom left corners of the screen. Numbers were considered BIS-related cues (based on novelty). 88% of the targets were letters, ensuring the BIS-related cues were rare (12%). Participants did not gain or lose any money if they withheld responses, but were told if they were correct or not. If they inappropriately responded they lost money, and if they responded correctly they made money. The results of the study were similar to those in Newman and colleagues (1997). Participants higher in psychopathy displayed weaker (BIS) inhibition than controls, and this effect was only significant for the group that was high in both anxiety and psychopathy (secondary psychopaths). The authors explained this discrepancy as being a function of participants with high BAS failing to appropriately allocate attention to information not directly related to the priority goal of seeking reward. The authors suggested that the addition

of cognitive load, and associated reduced prefrontal cortex activation (PFC; Gray & Burgess, 2004), may reflect an early attentional bias that would result in less need for cognitive control.

Response Modulation

Newman and colleagues have hypothesised a mechanism by which psychopaths fail to make appropriate associations in situations of competing reward/punishment contingency demands (see reviews by Gorenstein & Newman, 1980; Kosson & Harpur, 1997; Newman, 1997, 1998; Newman & Lorenz, 2002). This mechanism is referred to by the researchers as the "response modulation hypothesis" and refers to the inability of psychopaths to incorporate, and properly attend to, important contextual cues while engaged in goal-directed behaviour.

According to Newman and colleagues the insensitivity to inhibitory cues associated with response modulation is attentionally mediated (Hiatt, Schmitt, & Newman, 2004; Newman & Lorenz, 2003; Zeier, Maxwell, & Newman, 2009).

Hiatt and colleagues (2009) found that while psychopathic participants did not differ from controls on a Stroop task, in a modified version where the color and word were spatially separated the authors found psychopathic participants displayed less interference than controls. This finding has been replicated elsewhere (Newman, Schmitt, & Voss, 1997; Smith, Arnett, & Newman, 1992). A major advantage of the modified task is the nature of the distractor. Spatially separating the distractor from the target in the task allowed the author to establish either a central or peripheral role of the distractor. The authors interpret these findings as indicating that where distractors are central, rather than peripheral to the task psychopaths are able to process the distractor. Differential processing, in this case facilitation, only occurs when the distractor is peripheral. Psychopaths seem less able to attend to peripheral cues and to incorporate these cues in their dominant response set.

Zeier et al. (2009) added additional precision to these findings by adding visual cues directing participants' attention to targets and distractors in a modified Flanker task. Primary psychopaths (low-anxious) displayed reduced reaction times in comparison with low-anxious controls when responding in conditions where distractors were peripheral to cued targets. When targets and distractors were cued, no differences between primary psychopaths and low-anxious controls emerged. This study provided additional evidence that a) primary psychopaths exhibit a response modulation deficit, and b) that response modulation deficits in psychopaths are attentionally mediated.

Reversal Learning

Research has also demonstrated deficits in reversal learning in psychopaths. Reversal learning involves changing behaviour based on changes in stimulus / reward contingencies. It has been argued that reversal learning is central to emotional and social behaviour (Rolls, 1999). In a sample of incarcerated psychopaths, Mitchell et al. (2002) explored response reversal using the Intradimensional/Extradimensional Discrimination (ID/ED) task. In this task the participant is taught to respond to one of two stimuli and then, having reached criterion, must reverse the response so that they respond to the other stimulus (Dias et al., 1996). The ID/ED task is a multi-component instrumental learning task requiring individuals to select between two stimuli presented on a computer screen based on feedback provided on the display ("correct", or "incorrect"). The stimuli presented are novel, and involve up to two dimensions (object shape and line colour). The correct stimulus for a discrimination is always specified by one dimension or the other (i.e., shape one whether it is paired with line one or line two; or line one regardless of the shape that it was paired with). There are nine stages to the task, and participants must demonstrate that they have learned each stage before moving on. This is demonstrated by

making the correct discrimination on eight consecutive trials. The authors found that psychopaths showed a selective response reversal deficit while performing similarly to control participants on the attentional set-shifting and learning components of the task.

However, in a sample of boys with psychopathic tendencies and controls, Blair, Colledge, and Mitchell (2001) found no group differences on the ID/ED task for psychopathic or controls. The discrepancy between the responses of the boys on the ID/ED and adult male psychopaths' performance raises, according to the Mitchell and colleagues (2002) the possibility that "OFC deficits observed in adult psychopathic individuals may develop as a secondary consequence of early amygdala dysfunction" (p. 2020).

Blair (2003, 2004) has attempted to bring together disparate findings with respect to processing fear, the role of the amygdala, and the frontal cortex, into the Integrated Emotions Systems model (IES). The IES model can, according to Budhani, Richell, and Blair (2006) be "an extension and development of the earlier fear (Lykken, 1995; Patrick, 1994) and empathy (Blair, 1995) positions" (p. 553). Essentially, amygdala dysfunction reduces an individual's responsiveness to the sadness and fear of potential victims, and an individual's ability to learn the stimulus-reinforcement associations that are crucial for moral socialization. Because of this, children with amygdala dysfunction do not learn to avoid using antisocial behaviours to achieve their goals. Children with psychopathic tendencies, then, will learn to use antisocial behaviour to achieve their goals. However, this purported stress on the amygdala does not imply that there are not other dysfunctional regions of the brain in psychopathy. There exist clear indications of VMPFC deficits in psychopaths especially in adults (LaPierre et al., 1995; Mitchell et al., 2002). However, according to Blair (2006), it is questionable whether or not these pathologies represent

fundamental aspects of psychopathy, or rather, are secondary consequences of the disorder brought about by behaviours such as persistent and versatile drug abuse.

To summarize, there are a number of ways in which the characteristics of the psychopath resembles that of individuals with prefrontal cortex damage including impulsivity, rule breaking, poor behavioural control, lack of realistic long term goals, and irresponsible behaviour (Hare, 2003). Laboratory evidence provides support for prefrontal cortex impairment in psychopaths based on evidence of poor fear conditioning (Hare & Quinn, 1971; Lykken, 1957), impaired response reversal in adult offender samples (Blair et al., 2001; Mitchell et al., 2002), and impaired response inhibition (e.g., Newman & Kosson, 1986). Evidence with respect to other aspects of frontal lobe functioning have been less consistent (Hare, 1984; Hare et al., 1990).

Somatic Marker Hypothesis

The Somatic Marker Hypothesis (SMH) was proposed by Damasio (1994), based on work with VMPFC lesioned patients. Damasio (1994) noted that VMPFC patients, similar to psychopaths, perform adequately on a wide-range of neuropsychological tests, but demonstrate poor social decision-making. While they are capable of verbalizing correct behaviour, this understanding does not carry through to behaviour.

The SMH (Damasio, 1994; Damasio, Tranel, & Damasio, 1991) is a neuropsychological model postulating a relationship between somatic states and decision-making. In keeping with the James-Lange theory of emotion (James, 1884), where bodily states precede the experience of emotion, the SMH posits that somatic states influence decision-making. Somatic markers are formed on the basis of learned associations between actions and consequences. These markers, once formed, produce physiological states, like "gut feelings" that shape behaviour by focusing

the individual's attention on stimuli that give rise to feelings indicative of positive or negative outcomes.

Iowa Gambling Task

Evidence in support of the SMH has largely stemmed from research employing the Iowa Gambling Task (IGT). In an effort to uncover the mechanism underlying the impaired social decision-making behaviour of VMPFC patients, Bechara, Damasio, Damasio, and Anderson (1994) created the IGT. Their aim was to produce "[a] task which simulates in real time, personal real-life decision-making relative to the way it factors uncertainty of premises and outcomes, as well as reward and punishment" (p. 8).

This IGT involves participants drawing from one of four decks per trial. Each trial reveals an amount won while every few trials randomly reveals both winnings and a penalty that must be paid. The first two decks carry high reward and high punishment but lead to an overall loss of money, while the second two decks display the exact opposite pattern (low reward, low punishment, overall gain). The IGT has been used effectively in numerous studies to examine participants' adaptive learning ability in a punishment and reward settings. Individuals with intact VMPFC eventually switch strategy from the high yield, high penalty decks, to the lower yield, but more profitable decks in the long-term (e.g., Bechara et al., 1994). In contrast, VMPFC patients fail to switch strategies (Bechara et al., 1994).

Bechara, Damasio, Tranel, and Damasio (1997) describe four learning periods within the IGT. In the pre-punishment period (prior to trial 20), participants have a high probability of avoiding punishment. By the 20th trial, the pre-hunch period occurs where there is a high probability of a few losses experienced and when control participants begin to show anticipatory SCR responses whereas individuals with VMPFC damage do not. The hunch period, which

occurs by trial 50, is where participants begin to develop conscious awareness that the bad decks were riskier and control participants display stronger anticipatory SCRs. The final conceptual period is occurs by trial 80, and where most participants can explain which decks were bad and good and why. The authors report finding that a number of participants who could not explain task contingencies still performed advantageously. Interestingly, participants with VMPFC damage who could articulate task contingencies still perform well on the task, and did not develop anticipatory SCRs (suggesting deficient somatic markers).

The IGT has been used to research decision-making in respect of a number of neuropsychological disorders including lesions in the right somatosensory and insular cortex (Bechara, Tranel, & Hindes, 1999), Huntington's disease (Stout, Rodawalt, & Siemers, 2001), chronic drug abuse (Bechara et al., 2001; Stout, Busemeyer, Lin, Grant, & Bonson, 2004; Yechiam et al., 2004), obsessive-compulsive disorder (Cavedini et al., 2002), and in pathological gamblers (Cavedini et al., 2002).

In addition to the VMPFC, research with the IGT in non-offender samples has also suggested the potential role of the amygdala in strategic updating following responses (Bechara, Dolan, & Hindes, 2002). Specifically, the amygdala is responsible for processing the emotional content of negative performance outcomes. Patients with amygdala damage tend to do poorly on the task, and display little to no somatic response to punishment (Bechara et al., 1999). While the PFC is central to priming the individual with the somatic state previously associated with the situation, a separate pathway, involving the amygdala, is implicated in strategic updating based on the emotional impact of outcomes. The connection between amygdala and SMH is discussed by Damasio (1996) in the context of a larger network of brain regions that may be recruited in the formation and retrieval of somatic markers.

Variables Affecting IGT Performance

A number of studies have found that participant characteristics, study design, and localization of neurological impairment can yield differential results on the IGT.

Age

A number of studies have demonstrated that participant age can have an impact on IGT performance. Bjork et al. (2004) found that adults, relative to adolescents, displayed greater brain activation when presented with monetary loss during the IGT. Further, adults, but not adolescents, displayed this activation in the VMPFC. These findings suggest two separate developmental trajectories, one associated with reward seeking, and one associated with harm avoidance.

Overman et al. (2004) examined the performance of 420 students ranging in age from 11-23 years. Sixty students in the sample were university students, the rest were recruited from school grades 6-12. Females were equally represented along with males. The authors administered both a variant of the IGT and the WCST. The authors found that while scores on the WCST did not differ as a function of age, IGT scores were positively correlated with age. Males performed better than females across age groups. This improvement became apparent after 50 trials. The authors cited frontal PFC maturation rate as a major reason for age differences in IGT scores. That WCST scores did not vary as a function of age was interpreted as reflecting that the WCST does not index the same frontal lobe function as the IGT. Previous research has found that prefrontal cortex function is indexed by tasks involving emotional salience (such as the IGT) and tasks involving reversal shifts (Breiter, Aharon, Kahneman, & Shizgal, 2001). It was also notable in Overman et al.'s (2004) study that polydrug use had a modest effect on the performance of participants on their version of the IGT.

Cauffman and colleagues (2010) conducted a study with community participants ranging from age 10 to 30, examining the impact of age on a modified version of the IGT. The IGT was modified to allow for independence of selections from advantageous decks from avoidance of disadvantageous decks. Specifically, participants made a pass/play decision when presented decks, rather than actively selecting decks. Participants also received outcomes in the form of total win or loss at each selection, and total points, rather than the value won or lost with an individual card selection. The authors did this so that participants would not unequally weight gains and losses separately and to attempt to limit the required memory load for participants. The authors found that younger participants made more disadvantageous choices relative to adults. Preferences for advantageous decks were present in all age groups higher than age 13, but avoidance of disadvantageous decks increased linearly with age. Male participants played more (made fewer passes) overall during the course of the task as compared to females.

Neuroscience studies support this dual-system perspective, suggesting that the nucleus acumbens and ventral striatum pay a more important role in reward processing, and the amygdala plays a more important role in punishment processing (Ernst & Spear, 2009). The orbitofrontal cortex, which has a long developmental period (Breiter et al., 2007; Sowell et al., 2003), modulates and organizes inputs from these regions when determining behaviour responses (Bechara et al., 2000).

Conscious Awareness

Fernie and Tunney (2006) found that informing participants that some decks are worse than others and to avoid those disadvantageous decks in order to win, improved participant's ability to distinguish advantageous from disadvantageous decks. Indeed, other studies have shown that regardless of instruction participants generally reach conscious awareness of task

contingencies as early as 20 trials into the task (Bowman et al., 2005), but that this conscious awareness is not always in synchrony with autonomic responses (Bechara et al., 1997).

Sex Differences

Studies examining the effect of sex differences on IGT performance have found that in adult populations males adopt a longer-term strategy when completing the IGT than females (Overman, 2004). Specifically, female participants demonstrate an increased preference for the disadvantageous or risky decks which yield greater short- rather than long- term rewards. Males also perform better on the task overall (Bolla et al., 2004; Reavis & Overman, 2001). The most promising explanation for these observed differences to date is one of neurological structures. For example, Bolla and colleagues (2004) have found that men demonstrated greater right-hemisphere activation during a decision-making task, whereas women demonstrated more left-hemisphere activation. Tranel et al. (2005) suggest that the effect of these neurological differences are that in men, problem-solving in the social/interpersonal domain is performed in a more holistic, gestalt-type mode (suggesting right-hemisphere involvement). In women, such problem-solving could be performed in a more analytic, verbally-mediated mode (left-hemisphere involvement).

Reversal Learning

Several studies have suggested that it is reversal learning, rather than deficient somatic markers that explains poor performance on the IGT in patients with VMPC damage (Fellows & Farah, 2003; Rolls, Hornak, Wade, & McGrath, 1994; Tomb, Hauser, Deldin, & Caramazza, 2002). The IGT may be seen to present a challenge with respect to reversal learning based on the need for participants to shift from initially rewarding decks to less rewarding. Because large losses do not typically occur at the outset of the task, a prepotent response is established in

favour of the high-payout deck. However, once the magnitude of the loss is understood, it becomes necessary to inhibit the prepotent response and shift to the lower risk decks. There is extensive evidence to suggest that reversal learning is associated with the orbitofrontal cortex (Dias et al., 1996; Thorpe, Rolls, & Maddison, 1983).

Neuroanatomical Specificity

IGT deficits have been found not only in patients with VMPFC lesions, but also in patients with amygdala damage. However, patients with amygdalar lesions display differential autonomic responses from individuals with VMPFC lesions. As discussed, whereas control subjects performing the IGT develop anticipatory SCRs prior to selection from the risky decks (Bechara et al., 1996), patients with amygdala lesions have been found not to acquire anticipatory SCRs and showed blunted SCRs to punishing feedback (Bechara, et al., 1999). Individuals with VMPFC lesions also failed to acquire anticipatory SCRs to the risky decks, but show comparable SCRs to controls in response to punishing feedback (Bechara et al., 1996). This suggests that at a cognitive level, VMPFC patients experience reward and punishment normally, but are unable to use the experiences to guide future behaviour, whereas in individuals with amygdala damage, participants display decision-making deficits due to impaired emotional responses during appraisal (i.e., relevant for strategic updating) rather than anticipation.

Patients with dorsolateral prefrontal cortex (DLPFC) lesions have also been found to perform more poorly on the IGT (Bechara et al., 1998). Likely related to deficient working memory and cognitive control (Bechara et al., 1998).

Modified Versions of the IGT

In order to add additional function specificity, control reward / punishment contingencies or control cognitive load, researchers have modified the IGT to fit their research questions. In a

study by Fellows and Farah (2005), decks were shuffled so as to permit large losses with risky decks in the initial trials. The authors found that the VMPFC deficient patients no longer showed deficient responding. Kovalchik and Allman (2006), in a sample of elderly individuals and undergraduate students, modified the IGT such that they used only two decks, and the reward was higher for one of the two decks. After 60, of 120, trials, the advantageous decks were reversed, and participants had to shift to the other deck. The reward contingencies remained the same (i.e., in both blocks of 60 trials, the first deck provided a payout of +1.00 and the second deck a payout of +0.50). The authors employed two versions of the task, one with a short prepotent period, and one with a long prepotent period. The distinction between the two versions being that for the long prepotent version of the task, the reward level remained relatively higher for the advantageous deck. The first 60 trials of the short prepotent deck have a similar contingency schedule to that of the traditional IGT taking more trials to observe gains with respect to the advantageous decks. The authors found that for those participants that developed a strong prepotent response favouring disadvantageous decks, they made fewer advantageous selections following the contingency reversal. The over 60 year old sample as a whole, unlike the younger sample, did not demonstrate impeded reversal learning, nor did they develop a strong preference in the first half of the task. The authors interpreted their findings as supporting the response reversal interpretation of the IGT performance of VMPFC patients, and also posited that the development of a strong prepotent response, and ambiguity, may be the reason that deficits are not typically observed with other measures of response reversal in VMPFC patients such as the WCST. Without the ambiguity and prepotent preference established, the emotive aspect of decision-making may not be engaged.

PSYCHOPATHY AND MODIFIED IGT

In a study examining the effect of level of educational attainment on IGT performance, the authors modified the IGT to examine the differential impact of reward and punishment (Davis et al., 2008). Participants were recruited from the general public through newspaper articles and advertisements placed in public institutions. The authors requested healthy adult volunteers, women and men between the ages of 25 and 50 years enrolled. Participants completed two versions of the IGT. The first version very closely resembled that of Bechara and colleagues (1994). In the modified version of the IGT, the contingencies were reversed, such that on each trial participants lost points, while gains were delayed and intermittent. Advantageous decks yielded high immediate punishment but higher future reward; disadvantageous decks yielded lower immediate punishment but lower future reward. The authors found, in addition to a significant effect of race such that Caucasian participants performed better than other races, education level had a significant impact on task performance. The overall trend for this task was for the number of correct selections to increase initially, but then decline in the latter trials. One possible explanation put forward by the authors for this finding was that, given a higher average score on the first four blocks of the modified task, relative to the standard IGT, is that some subjects exceeded the total possible number of cards from the "good decks" they had selected, and then resorted to "bad decks". This, however, seems somewhat unlikely given that a) there were two advantageous decks to find and "deplete", and b) that in the standard version of the IGT, the "good decks" did not display a similar trend for depletion.

SMH and Psychopathy

Based on work with individuals with frontal lobe damage, mainly VMPFC, whose behaviour may be seen to mimic that of some psychopaths (i.e., demonstrating a lack of

inhibition, impaired social decision-making, unimpaired general cognitive function), it has been suggested that psychopaths may possess deficient "somatic markers" (Damasio, 1994).

Given the putative similarities between psychopaths and individuals with VMPFC lesions, Schmitt, Brinkley, and Newman (1999) examined the performance of incarcerated psychopaths on the IGT. In their study, incarcerated psychopaths and nonpsychopaths were also assessed on anxiety based on Welsh Anxiety Scale (WAS; Welsh, 1956) scores. The IGT task was a computer-based variant of the original task designed by Bechara et al. (1994, 1997), and while similar, there were two notable differences. First, the reward set used in the experiment involved "real" rather than "pretend" money. Risky decks yielded 10¢, with penalties from 15¢ to $1.25, and the less risky decks yielded rewards of 5¢ with lower and more frequent penalties of 3¢ to 25¢. Second, the participants were not explicitly told that some decks involve more loss than others, and that participants could win more money overall if they avoided those decks. The authors found that, while high-anxious participants became more risk averse over time relative to low-anxious participants, psychopathy did not significantly predict task performance. Further, conducting additional hierarchical correlational analyses, the authors found a significant interaction between psychopathy and anxiety. It should also be noted that the authors, at the behest of reviewer recommendations, also examined the contributions of the two-factor model of the PCL-R (Harpur et al., 1989) in predicting task performance. For both Caucasian and African-American groups, neither factor nor their interaction accounted for a significant proportion of the variance in task performance.

Lösel and Schmucker (2004) examined adult male German inmates behaviour when playing the IGT. Play money closely approximated real money and the task was not computerized. The authors conducted correlational analysis between psychopathy and IGT

performance, and also split the sample according to a PCL-R cutoff score of 25. The sample was also subdivided, prior to game play, based on attention scores (Brickenkamp's d2 test; Brickenkamp, 2002). The authors found no significant relationship between psychopathy and gambling task performance. However, psychopathic inmates with low attention scores performed more poorly on the task than psychopathic inmates with high attention scores. In this task, participants were provided with instructions regarding the potential to lose money differentially on decks, and also provided with larger-scale (fake money), bringing the task parameters more closely in line with Bechara and colleagues (1994) original design. That psychopathic offenders with low attention scores performed more poorly than those with high attention scores was interpreted by the authors as being consistent with the SMH and response modulation. High attention scoring psychopathic offenders may perform better on the task because their improved attention compensates for a VMPFC deficit. High levels of attention allow participants to keep relevant information available.

While none of the above studies involved a comparison of psychopaths with an individual with PFC trauma, or individuals displaying similar trauma, this has been done in only one published study. In this case study involving a comparison with five psychopathic and five nonpsychopathic inmates, Blair and Cipolotti (2000), compared individuals with other forms of neurological trauma corresponding with frontal lobe damage related disinhibitory behaviour ("acquired sociopathy"), and other forms of dysexecutive disorder, with psychopathic or "developmental psychopath" individuals (denoting primary psychopathy). Psychopathic inmates showed no impairment on the IGT.

Mitchell et al. (2002), examined the performance of psychopathic and nonpsychopathic inmates in a British high security prison. Participants played a computer-based variant of the

IGT, and instructions regarding the task and the outcome were provided to participants (i.e., avoiding some decks would lead to less loss). The authors found a significant block (of 20 trials) and group interaction. Participants in general became more risk-averse over time and non-psychopathic inmates made fewer disadvantageous deck selections. There was also a significant block by group interaction suggesting that non-psychopathic participants learned to avoid the disadvantageous decks more quickly, relative to psychopathic participants. Mitchell and colleagues (2002) suggested that "the greater impairment seen in adult psychopathic individuals may arise as a secondary consequence of the behavioural characteristics of the disorder" (p. 2020). For example, psychopathy has been associated with higher rates of drug abuse (Hemphill, Hart, & Hare, 1994; Smith & Newman, 1990). Further, studies have shown impaired performance on the gambling task in alcohol and drug dependent individuals (Bechara, Dolan, Denburg, Hindes, Anderson, & Nathan, 2001; Grant, Contoreggi, & London, 2000), and that deficient decision-making and deliberation time is associated with focal orbitofrontal damage, and individuals abusing amphetamines or opiates (Rogers et al., 1999). Given that both frontal lobe deficits may be associated with both psychopathy and drug and alcohol abuse, and that drug and alcohol abuse is elevated in psychopaths, a clear gap in the literature exists with respect to the relative contribution of a drug and alcohol abuse history and psychopaths' performance on tasks thought to rely on frontal lobe function (including the IGT).

To date, there have been three published studies examining the relationship between psychopathy and IGT performance in community samples (Mahmut, Homewood, & Stevenson, 2008; Morgan, Gray, & Snowden, 2011; van Honk, Hermans, Putman, Montague, & Schutter, 2002).

van Honk et al. (2002) examined the BIS and BAS self-report measure (Gray, 1987) scores as a proxy for psychopathy in a sample of students attending a university in the Netherlands. Using an extreme groups design, the authors compared students scoring extremely low on the BIS/high on BAS, and students scoring high on BIS/low on BAS (half of each were female). These participants played a computerized version of the IGT, using fictional money. The authors found that high psychopathy (i.e., strong BAS / weak BIS) participants failed to learn to avoid the risky decks, resulting in significant group interactions, at each of five periods of game play. Of particular note in this study was a clear increase in risky decisions in the fifth and final period of the experiment, for the high "psychopathy" group. The authors juxtapose these findings with the fact that, as found in previous research examining IGT play in normal populations, there is a point at which participants slowly gain conscious awareness of the game (Tranel et al., 2000), high psychopathy participants had most likely gained conscious awareness. That psychopathic individuals failed to learn to avoid risky decisions, while conscious of the game parameters and strategy, was interpreted by the authors as supporting the extension of the SMH, and corresponding orbitofrontal functioning deficit, to psychopathy. It is difficult to agree with this interpretation, however, given that no autonomic indices were collected during the course of the task.

In a sample of undergraduate students from Australia, Mahmut et al., (2008) divided groups based on the SRP-III (Paulhus et al., in press) scores into higher and lower psychopathy groups. In order to avoid "contaminating psychopathy with antisocial behaviour" the top 30% and bottom 30% of participants were assigned based on SRP-III scores excluding the Criminal Tendencies factor. Performance on a version closely resembling the standard IGT was measured based on the number of risky decisions made by block of 20 card selections (trials) and the total

number of risky selections. The authors found that male and female participants, overall, and in the psychopathy sub-grouping, did not differ in their number of risky card selections, total or by block. Psychopathy did predict a poorer performance, but this was largely restricted to the second half of the task (trials 51-100). Further, of the SRP-III facets, Criminal Tendencies and Interpersonal Manipulation facets predicted the greatest diversion from the risky decision pattern of controls (i.e., participants assigned to psychopathy sub-groups based on these factors made more risky decisions) (supplementary analyses; Mahmut et al., 2008). These findings suggested to the authors that, taken with other previous research, "non-criminal and criminal psychopaths are not qualitatively distinct populations but share similar psychophysiological and neurological characteristics," and that, "non-criminal and criminal psychopaths most likely differ in terms of degree..." (Mahmut et al., 2008, p. 690). That the authors found that differences between high and low psychopathy groups emerged in that latter half of the trials would seem congruent with the findings of van Honk et al. (2002) where later trials yielded the greatest separation between groups. Whereas van Honk et al. (2002) argued that this difference may be one of conscious awareness. Another possible explanation for the difference between psychopathy groups emerging at later trials is that a propensity for risk taking or trait impulsivity are factors contributing to performance differences.

Morgan et al. (2011) examined the effect of psychopathy on impulsivity in a sample of 80 male and female adults (mostly students) recruited from the community. Psychopathy was measured using the PPI. Interestingly, the authors selected the IGT as one of a number of tasks measuring impulsivity. The authors found a) that of the impulsivity measures only IGT total score was significantly related to psychopathy, b) supplementary analysis only found a significant correlation between psychopathy and IGT performance for male participants, and c)

that neither of the two PPI sub-factors, low fear (PPI-I) or regulatory dysfunction (PPI-II), defined according to Benning and colleagues (2003), were significantly related to IGT performance. The authors interpreted the overall findings as consistent with Mahmut et al. (2008). To address the sex differences found in their study the authors cited research suggesting that risky impulsivity may be particularly relevant in males and aggressive/externalizing disorders (e.g., Campbell & Muncer, 2009). No differences in IGT performance were found between male and female participants.

The majority of the studies reviewed here suggest a relationship between psychopathy and performance on the IGT. This holds true in offender and undergraduate student samples. However, existing research also suggests that there may be specific key points in the task where differences between psychopaths and controls emerge. Given that conscious awareness of task performance emerges at later stages of the task, differences between psychopathy groups observed in youth (Blair et al., 2001) and university students (Mahmut et al., 2008; Morgan et al., 2011; van Honk et al., 2002) may be more closely related to maintenance rather than acquisition of an advantageous strategy on standard versions of the IGT. Taken with other findings with respect to frontal lobe deficits, and differential relationships between facets of psychopathy and physiological responses, drug and alcohol abuse, and psychopathy subtypes, there exist a range of variables to take into consideration when designing task parameters and selecting appropriate measures. Further, of particular note are findings suggesting the relationship between physiological responses and cognitive task performance may differ between offender and undergraduate student samples warrants further study.

Current studies

This dissertation builds on previous research on the impact of psychopathy on IGT task performance by: (1) modifying the IGT to test whether psychopathy predicts deficient reversal learning under ambiguity; (2) including indicators of autonomic activity; (3) studying both offender and undergraduate samples; (4) determining if anxiety interacts with psychopathy in MIGT performance; and (5) controlling for the impact of drug and alcohol problems.

Psychopathy in the undergraduate sample will be assessed using the PCL:SV. Previous research on the relation between psychopathy and IGT performance used self-report measures to assess for psychopathic traits (Mahmut et al., 2008; Morgan et al., 2011; van Honk et al., 2002). The PCL:SV is more comparable in administration to the PCL-R and includes collateral information (in this case an interview with a close friend or family member) in addition to a face-to-face semi-structured interview with the participant. The four-factor model of psychopathy will be employed in this study to determine if there are differential relations between physiological response or task performance with the factors of the PCL:SV and PCL-R in undergraduate students or offenders.

The Modified Iowa Gambling Task (MIGT) used in this study includes four decks. Gain and loss contingencies reverse between advantageous and disadvantageous decks after 60 trials, and the task will end after 120 trials. While most studies examine implicit learning with the IGT over 100 trials, studies have been used comparing participant performance on shorter versions of the IGT, including a 60 trial version adopted to avoid participant fatigue (Girardi, MacPherson, & Abrahams, 2011). Sixty trials should be sufficient for participants to develop a prepotent response, and may decrease the likelihood that participants reach conscious awareness of task contingencies.

No published study to date has examined autonomic responses by criminal or community participants during the IGT. For those studies not focused on psychopathy, most restrict their analysis to SCR. By including HR, this study expands measurement over a wider range of bodily systems and may shed additional light on the extent to which somatic markers may be modifying participant behaviour or occurring in response to the magnitude of gains or losses.

Trait anxiety was also included in the analysis based on previous research by Schmitt et al. (1999) to determine whether or not their findings can be replicated with the MIGT in the offender sample, and whether the interaction between anxiety and psychopathy will yield differential results in the undergraduate sample.

The hypotheses, methods, and results for undergraduate versus offender samples will be described separately in Study 1 and Study 2, respectively.

Study 1

Hypotheses

Based on research findings in university student samples (Mahmut et al., 2008; Morgan et al., 2011; van Honk et al., 2002) it was hypothesized that psychopathy would predict poor performance on the MIGT. While no published research to date has examined the interaction between anxiety (WAS scores) and psychopathy (PCL:SV total scores) on IGT performance in undergraduate students, it was also hypothesized that there would be an interaction between WAS scores and psychopathy on MIGT performance. Based on some preliminary evidence of the impact of polydrug use on IGT performance in young adults (Overman et al., 2004) and drug and alcohol use on the IGT more generally (Becahara et al., 2001; Grant et al., 2000), it was also hypothesized that controlling for drug and alcohol abuse (DAST / MAST scores) may weaken the magnitude of the relation between psychopathy and MIGT task performance.

While not a direct comparison, based on Dindo and Fowles' (2011) study examining SCR responses and psychopathy in an undergraduate student sample, it was hypothesized that SCR responses during the MIGT would be related to psychopathy. Specifically, Facet 1 (Interpersonal) and 2 (Affective) of the PCL:SV would be inversely correlated with SCR responses in anticipation of making selections from disadvantageous decks, and Facets 3 (Lifestyle) and 4 (Antisocial) would be positively correlated with SCR responses following selections from disadvantageous decks (appraisal). Analyses of HR responses were exploratory in nature.

Method

Participants

Undergraduate participants were recruited through Carleton University's undergraduate student recruitment program. Students participating in the current study were provided with either course credit or $10 for each hour of participation.

Seventy-six undergraduates participated in the study. Participant MIGT data were not available for 11 undergraduate students due to technical failure or participant refusal leaving, a sample size of 65 (19 male, 46 female) undergraduate students. Ages ranged from 18 to 27, (M = 18.87, SD = 1.78). Fifty-seven of the undergraduate students were female and the remaining 19 were male. Participants varied in race: 74% of the sample was White, 18% Asian, 6% Black, and 5% of other backgrounds.

Task

The card task in this experiment was computer-based, and implemented in the E-Prime software package Version 1.0 (Psychology Software Tools Incorporated, 2002).

The Iowa Gambling Task (IGT; Bechara et al., 1994) was designed to approximate a social decision-making scenario requiring participants to repeatedly select a card from an array of four decks, labelled A, B, C, and D. Each selection always results in an immediate positive outcome. Decks A and B carry bigger wins, while C and D lead to smaller monetary rewards. However, a win may also be immediately followed by a subsequent negative outcome. Penalties are arranged such that selecting from the disadvantageous decks (A and B) produce an overall loss of money. Therefore, the better strategy is to select from advantageous decks (C and D) that yield an eventual profit.

With the original form of the IGT each deck is composed of 40 cards, participants are given a certain amount of play money and they are told that their goal is to win as much money as possible by the end of the game. Participants are then asked to select one card at a time from any of the four decks until they are told to stop. They are free to switch from any deck to another, but they are not informed about how many selections they have to make. Participants are not told that the experiment will be stopped after 100 trials. Once a card is chosen, it is turned over and it allows the participant to gain some money. The amount of which varies depending on the deck. Turning any card from deck A or B yields $100 to the participant; turning any card from deck C or D yields $50. However, the net yielding of each deck varies because the penalties also vary with the decks. In particular, decks A and B assure high wins but are also associated with higher losses (up to $1250); decks C and D are associated with both small wins and small penalties (for

a maximum of $100). The payoff sequence is also unknown to the participants, and is arranged in a manner that makes it difficult to learn the long-term effects of each deck.

The task used in this study is a modified version of the IGT (MIGT). This task is very similar to that developed by Bechara and colleagues (1994), with the following differences: (a) participants are told that some decks are better than others; (b) they are given electronic points instead of money, which are displayed numerically rather than graphically or by tokens; (c) there is a two second pause before and a six second pause after participants can make selections to ensure a full SCR; (d) there are 120 trials; (e) point gains and losses are displayed concurrently with gains in green on the left hand side and losses in red on the right; a running total is also displayed underneath the gains and losses; and (f) half way through playing the game, the punishment and reward contingencies reverse and decks A and B become the advantageous decks, rather than C and D. Instructions are provided on screen and by the researchers. There is also no limit on the number of cards that can be selected from each deck.

Psychophysiological Recording and Quantification

Skin conductance response (SCR) was recorded from adjacent sites on the hypothenar eminence of the non-dominant hand using Coulbourn Instruments 1-cm Ag-AgCl electrodes filled with Grass instruments EC33 skin conductance paste. Electrode leads were connected to a Coulbourn S71-23 Isolated Skin Conductance Coupler. The coupler imposed .5 volts across the electrodes. Skin conductance was recorded in μS. SCR was defined as the peak amplitude of the response.

Heart rate activity (HR) was recorded from Coulbourn Instruments 1-cm Ag-AgCl electrodes positioned on the right and left inner forearms, and connected to a Coulbourn S75-01 High Gain Bioamplifier. Digital sampling was accomplished using a DATAQ DI-720 series data

acquisition system. Sampling rate was 240Hz. A custom signal reduction procedure was developed by the researcher applying a combination of: (a) 1 Hz high pass and 40Hz low pass filter; (b) the identification of peaks (and attenuation of unwanted noise) using the Treethresh package (Evers, 2009), for the open source R statistical software language (R Development Core Team, 2010) version 2.12.1, which contains functions for applying tree-based locally adaptive thresholding; (c) identifying peaks (R-waves), and calculating inter-beat intervals (IBI); (d) rejecting unrealistic inter-beat intervals, resampling, and then returning the mean IBI for the response or anticipatory epoch; and (e) converting IBIs to beats per minute.

HR and SCR responses were examined in a variety of ways to attempt to control for the impact of data loss through factors such as noisy signals, movement artifacts, and poor (undetected) collection site adherence. Where cell data loss for analysis exceeded 10 percent, the trace data was discarded.

Measures

Performance

Deck selection data was quantified similar to Mahmut and colleagues (2008). The 120 card selections were divided into six 20-block trials and a net score (Netscore) was calculated for each block. Netscore was derived by summing the number of selections from advantageous decks and subtracting from this, the number of selections from disadvantageous decks. In the MIGT this differed by block such that for the first 60 trials advantageous decks were decks C and D, and for the last 60 trials the advantageous decks were A and B. Thus Netscore was calculated as:

- Trials 1-60: (C + D) - (A + B); and
- Trials 61-120: (A+B) - (C + D).

Netscores less than zero reflect disadvantageous deck selection, whereas positive Netscores indicate advantageous deck selection.

In order to examine the ability of participants to effectively reverse their deck selections between the first and second 60 trials of the task, repeated measures analyses were conducted using Block 3 and Block 6 of the task. These Blocks were selected in order to allow for the initial learning period before, and after the deck contingencies were reversed.

Anxiety

Anxiety was assessed using the Welsh Anxiety Scale (WAS; Welsh, 1956). The WAS, adapted from the MMPI (Hathaway & McKinley, 1943), is a 39-item questionnaire used as a measure of an individual's disposition to experience negative affect and anxiety (Welsh, 1956). Items are in a true-false form. All true responses, except for item 20 – "I very seldom have spells of the blues" are summed to produce the scale total (see Appendix A for WAS items). According to Gray (1987), individuals with this type of anxiety are more sensitive to punishment cues, and display better passive avoidance than controls. This finding has been supported in studies involving extraverts and in test anxiety situations (Avila et al., 1995; Hagopian & Ollendick, 1994).

Drug and Alcohol Abuse

This was assessed using the Michigan Alcohol Screening Test (MAST; Selzer, 1971) and the Drug Abuse Screening Test (Skinner, 1982). The MAST consist of 22 yes/no questions. A total score of six or more out of a possible 22 indicates hazardous drinking or alcohol dependence. The DAST (Skinner, 1982) was designed to screen for drug abuse problems for clinical screening and treatment evaluation research. The 28 self-report items tap various consequences that are combined in a total DAST score to yield a quantitative index of problems

related to drug misuse. A score of 11 or more is considered to be a reliable cut off score for identifying substance abuse problems. A review by Maisto, Gerard, and Allen (1995) of the MAST suggested a high level of sensitivity for screening for alcohol issues when compared with other screening instruments. Studies indicate that the long version of the MAST possesses good internal-consistency reliability, as indicated by Cronbach's alpha coefficients of .83 to .93 (Gibbs, 1983). See Appendix B for items on the MAST.

A rewiew by Yudko, Lozhkina, and Fouts (2007) references Cronbach's alpha coefficients ranging from .92 to .94 for the 28-item version of the DAST, and a test-retest reliability of .85. The measure has high face validity, and previous studies have demonstrated a high-moderate correlation between the MAST and DAST for men (El-Bassel et al., 1997) and women (Salstone et al., 1994). See Appendix C for DAST items.

Physiological Response

Analysis of psychophysiological response involved the measurement of anticipatory and appraisal response. Anticipation response was calculated based on averaged peak SCR and HR response during one to two second periods prior to card selection in the MIGT. Appraisal response was calculated based on average peak SCR, and HR response during the six second period where participants view the results of their selections. Average appraisal and anticipatory responses were further sub-divided into selections from advantageous and disadvantageous decks similar to previous studies using these measures (e.g., Bechara et al., 1996; Jenkinson et al., 2008). All recording periods fell within one to six seconds to balance the ability to capture stimulus elicited responses in physiology as well as give participants adequate time to consider their responses.

Psychopathy

Psychopathy was assessed using the Psychopathy Checklist: Screening Version (PCL:SV; Hart et al., 1995). The PCL:SV is a 12-item clinical rating scale designed to measure interpersonal, affective, and behavioural characteristics of psychopathy. Items 1-3 which comprise Factor 1, measure the interpersonal symptoms of psychopathy; items 4-6 measure the affective symptoms; items 7,9,10 measure the lifestyle symptoms; and items 8,11,12 measure the antisocial symptoms of psychopathy. Each item is rated on a 3-point scale with 2 indicating the item definitely applies, 1 that it may or may not apply, and 0 that it definitely does not apply to the participant. The items are then summed to yield a total score that ranges from 0-24 with a diagnostic cut off of 18 for psychopathy (Hare et al., 1995). The PCL:SV is scored on the basis of information from interview and collateral information. In this study, collateral information was collected via phone interviews with individuals identified by the participant as knowing him or her well.

Previous studies using the PCL:SV in community samples have found the instrument to have high internal consistency. Two studies, for example, found Cronbach's alphas of .89 (Malterer, Lilienfeld, Neumann, & Newman, 2010) and .84 (Neumann & Hare, 2008) for total PCL:SV scores. Internal consistencies for facets have also been found acceptable despite the low number of items in each facet. Neumann and Hare (2008) found alphas ranging from .65 (Interpersonal) to .75 (Lifestyle).

Interviews were recorded, and later scored along with relevant collateral information by a trained research assistant to determine the level of agreement by calculating single measure Intraclass Correlation Coefficients (ICCs; Bartko, 1976). Ten percent of participants (n = 7) were randomly selected and scored blindly by the trained research assistant. Single measure ICCs were: PCL:SV Total = .80, Facet 1 = .74, Facet 2 = .61, Facet 3 = .92, and Facet 4 = .77. The

ICCs with this sample are consistent with previous studies reporting acceptable ICCs when scoring the PCL:SV in community samples (Forth et al., 1996; Malterer et al., 2010).

Procedure

Undergraduates were provided with a briefing on the overall experiment, and asked for informed consent. If informed consent was granted, participants were interviewed in a lab on campus. Undergraduates were provided with anxiety, drug and alcohol questionnaires and then, after a break, asked to complete the MIGT. Before completing the task on a laptop in the university laboratory, electrodes were attached to the participant's hand for skin conductance response, and the arm for heart rate, and leads were connected to the Coulbourn Instruments panel.

Once recordings were made, and any needed adjustments to the leads, or electrode placement, the participant was asked to follow the instructions on the computer screen and to begin when comfortable. The experimenter remained in the room and was available to correct electrode placement or answer any questions as required.

Following completion of the tasks, the participant was provided with a debriefing on the experiment and thanked for their participation. Arrangements were made for course credit, or monetary remuneration. Collateral interviews were conducted separately by telephone at least 48 hours following the participant interview. This was done to ensure that participants had an opportunity to contact their collaterals in advance.

It should be noted that for both Study 1 and Study 2, no effort to counter-balance task completion and interviews was made. In many cases, due to time demands for student schedules or for inmate movement in Study 2, interviews were conducted either before or after task performance.

Data Screening

For all models, data were screened for univariate outliers that fell outside of three standard deviations away from the mean. Variables were examined for normality of sampling distribution, linearity, homogeneity of variance, and, in the case of mixed ANCOVA models, reliability of covariates (Tabachnick & Fidel, 2007). Screening for multivariate outliers was accomplished using Mahalanobis distance. Cases falling outside of the recommended cutoff were removed for those specific analyses.

In terms of participant data loss, during the early phase of the study, HR and SCR were not recorded during IGT sessions (i.e., the first 12 participants).

Results

Descriptive Statistics

Overall, PCL:SV scores were lower in this study than other studies with undergraduate student samples (e.g., Forth et al., 1996; Malterer et al., 2010). Female and male students did not differ on the WAS, DAST, MAST, or PCL:SV Total or Facet scores. Male and female undergraduate students did differ on age, with females younger (M = 19.39, SD = 1.41) than males (M = 20.47, SD = 2.61), F (1,63) = 4.69, $p < .05$.

Internal consistency for the PCL:SV and facet scores were all in the moderate to high range. DAST and MAST internal consistency scores were in keeping with results from community samples (Selzer, 1971; Skinner, 1982).

Table 3 displays descriptive statistics for psychopathy, anxiety, and drug and alcohol measures WAS, DAST, and MAST in the undergraduates.

Table 3

Means (M) and Standard Deviations (SD) for Measures (PCL:SV, MAST, DAST, WAS) for Female and Male Undergraduates

	Total			Females			Males			Test	
Measure	*M*	*SD*	*α*	*M*	*SD*	*α*	*M*	*SD*	*α*	*F*	*p*
PCL:SV Total	2.49	3.24	.89	2.13	3.07	.90	3.37	3.56	.85	1.99	.16
Facet 1	.60	1.10	.69	.48	1.01	.66	.89	1.29	.72	1.95	.17
Facet 2	.42	.75	.81	.37	.68	.72	.53	.91	.93	.59	.45
Facet 3	.71	.93	.58	.61	.91	.67	.95	.97	.82	1.80	.18
Facet 4	.77	1.13	.60	.67	1.03	.60	1.00	1.33	.62	1.12	.29
DAST	3.94	4.21	.84	3.91	4.38	.84	4.00	3.89	.81	.01	.94
MAST	1.69	1.68	.64	1.61	1.64	.64	1.89	1.79	.61	.39	.54
WAS	11.42	7.38	.87	11.89	6.85	.86	13.68	8.60	.90	.79	.38

Note. PCL:SV = Psychopathy Checklist: Screening version; WAS = Welsh Anxiety Scale; DAST = Drug Abuse Screening Test; MAST = Michigan Alcohol Screening Test; ES = Effect size (Cohen's *d*; Cohen, 1977); *α* = Cronbach's alpha measure of internal consistency; *n* = 65 (19 males, 46 females).

Performance on the MIGT

Given the large difference in the proportion of the sample that was male versus female, a post-hoc analysis of the effect of sex on MIGT performance was examined. An ANOVA with total Netscore as the dependent variable (DV), and sex as the independent variable (IV) was found to be significant, $F(1,63) = 7.33, p < .01$, with males exhibiting a lower total Netscore ($M = -22.95$, $SD = 7.07$) than females ($M = .48$, $SD = 4.73$). To determine if differences were related to specific blocks of trials, Sex by Netscore one-way ANOVAs were calculated for each Block of 20 trials. The difference between groups on Block 6 was significant, $F(1,63) = 10.14, p < .05$, with males earning lower Netscores in this block ($M = -6.63$, $SD = 10.26$) than females ($M = 2.91$, $SD = 11.27$). Table 4 displays means and standard deviations by block of the MIGT for male and female undergraduates.

Table 4

Means (M) and Standard Deviations (SD) for MIGT Netscores by Block and Sex in Undergraduates

	Total		*Females*		*Males*		*Test*	
Blocks	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*
Block 1	-3.35	7.6	-3.04	7.69	-4.11	7.53	.26	.61
Block 2	-.86	9.58	.13	9.67	-3.26	9.15	1.71	.20
Block 3	-1.88	7.93	-1.04	8.32	-3.89	6.65	1.76	.19
Block 4	.03	6.75	.43	7.51	-.95	4.44	.56	.46
Block 5	-.43	10.17	1.09	10.19	-4.11	9.39	3.65	.06
Block 6	.12	11.75	2.91	11.27	-6.63	10.26	10.14	<.01

Note. Block = Block of 20 trials; All degrees of freedom are 1,63 for all tests; n = 65 (19 males, 46 females).

In order to explore the relationship between measures of anxiety, drug, and alcohol abuse, WAS, DAST, and MAST scores were correlated with performance on the MIGT. No significant relationship between these measures and task performance were found. Results are displayed in Table 5.

Table 5

Bivariate Correlations Between MIGT Task performance, WAS, MAST, and DAST scores for Undergraduates

Variable	*WAS*	*MAST*	*DAST*
Block 1	.12	-.09	-.06
Block 2	.23	-.09	-.05
Block 3	.09	-.06	-.01
Block 4	-.04	-.09	.10
Block 5	.05	.08	.21
Block 6	.07	-.01	.10

Note. Block = Block of 20 trials on the MIGT; $n = 65$ (19 males, 46 females); WAS = Welsh Anxiety Scale; DAST = Drug Abuse Screening Test; MAST = Michigan Alcohol Screening Test.
* $p < .05$

The primary hypothesis in this study was that psychopathy would predict poor performance on the MIGT. With the exception of Facet 1 at Block 2, psychopathy, including Facet scores, did not predict poor performance on the MIGT in undergraduates. In the undergraduate sample Facet 1 (Interpersonal) of the PCL:SV was significantly inversely correlated with Netscore at Block 2 (Trials 21-40) ($r = -.26, p < .05$). This effect was more pronounced in male students ($r = -.45, p < .05$). There were no significant correlations between task performance and PCL:SV Total or Facet scores. Table 6 displays bivariate correlations between Psychopathy (PCL:SV total and Facet scores) and Netscore by Block for undergraduates overall and by sex.

Table 6

Bivariate Correlations Between MIGT Task performance, PCL:SV Total and Facet Scores for Undergraduates Overall and by Sex

PCL:SV	Block 1	Block 2	Block 3	Block 4	Block 5	Block 6	Total
			Total Sample				
Total	-.13	-.22	-.09	.02	.13	-.08	-.10
Facet 1	-.13	-.26*	-.06	.04	.22	-.04	-.06
Facet 2	-.05	-.20	-.13	-.01	.07	-.13	-.12
Facet 3	-.14	-.21	-.10	-.01	.02	-.10	-.15
Facet 4	-.09	-.09	-.05	.02	.10	-.03	-.03
			Females				
Total	-.03	-.14	-.13	-.06	.04	.22	.003
Facet 1	-.06	-.12	-.06	.04	.22	.23	.09
Facet 2	-.06	-.14	-.17	-.03	.09	-.04	-.09
Facet 3	-.02	-.23	-.16	.04	.06	.02	-.08
Facet 4	.02	-.02	-.09	-.03	.15	.13	.05
			Males				
Total	-.31	-.33	.11	.12	.25	-.34	-.17
Facet 1	-.25	-.45*	.04	.12	.39	-.42	-.20
Facet 2	-.02	-.28	.01	.10	.13	-.24	-.11
Facet 3	-.38	-.10	.17	-.14	.07	-.22	-.15
Facet 4	-.28	-.16	.13	.24	.17	-.19	-.07

Note. Block = Block of 20 trials on the MIGT; $n = 65$ (19 males, 46 females).
* $p < .05$

To examine the extent to which participants mastered the MIGT, given its increased level of difficulty and abbreviated number of learning trials (i.e., a maximum of 60 trials to learn to shift from disadvantageous to advantageous decks), an overall percentage of the participants demonstrating impaired performance was calculated. Similar to Bechara and Damasio (2002), impaired performers were defined based on overall Netscore threshold. Netscores, based on the sum of each of the six blocks of 20 trials, of less than zero were considered indicative of poor performance. In the undergraduates 42 out of 65, or 65% of participants displayed an impaired performance on the MIGT. While higher than the proportion of impaired performance reported in other studies (Bechara & Damasio, 2002; Bechara et al., 2001), some studies with normal controls report similar proportions of poor performers with the standard IGT (e.g., Jenkinson et al., 2008). Overall, the undergraduates did not display a significant trend to improve across the six trials, $F(6,60) = .88$, $p = .11$. Nor was there a significant interaction with sex, $F(5,59) = 1.54$, $p = .19$. The non-significant trend is displayed in Figure 1 for total sample and separately for males and females in Figure 2.

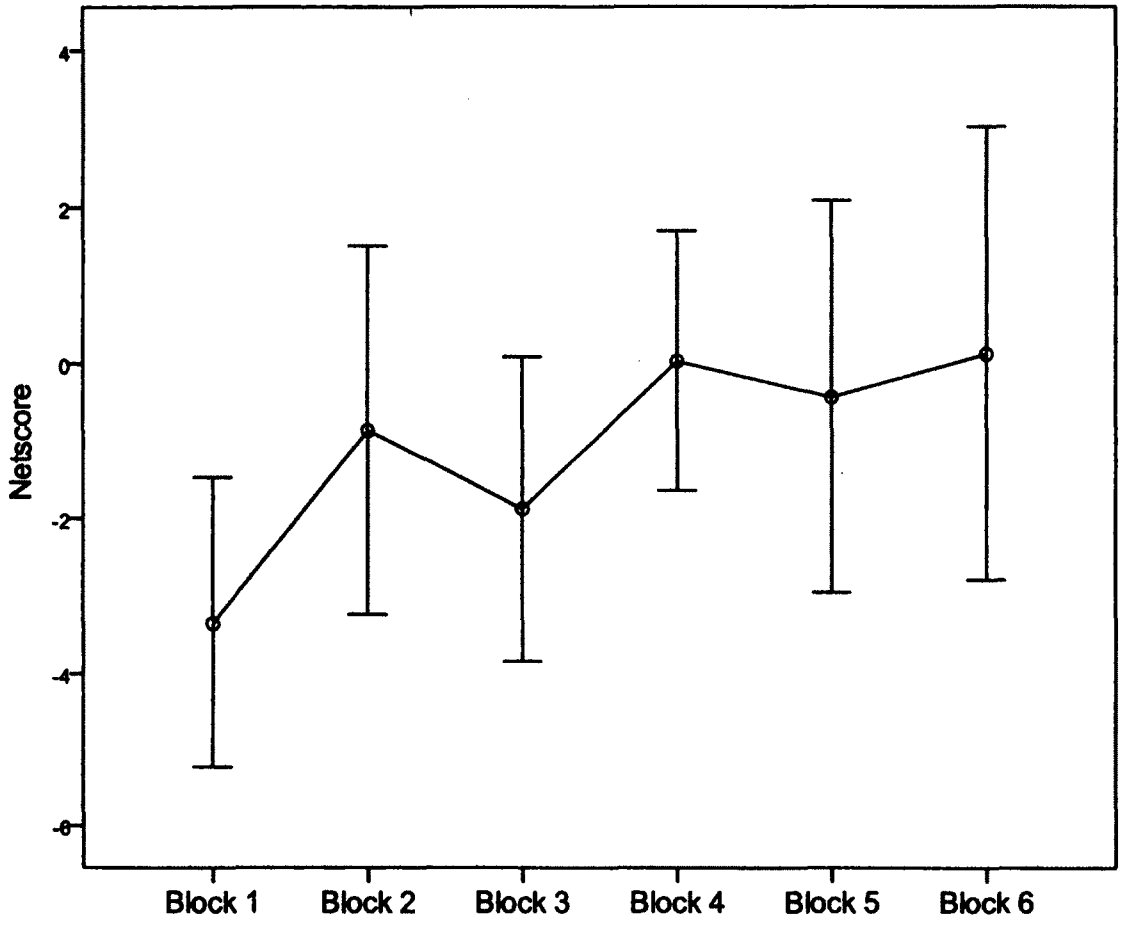

Figure 1. Mean Netscores per block of 20 trials. Error bars represent standard error in each block. The change in deck contingency occurs at the beginning of Block 4 (i.e., at Trial 61).

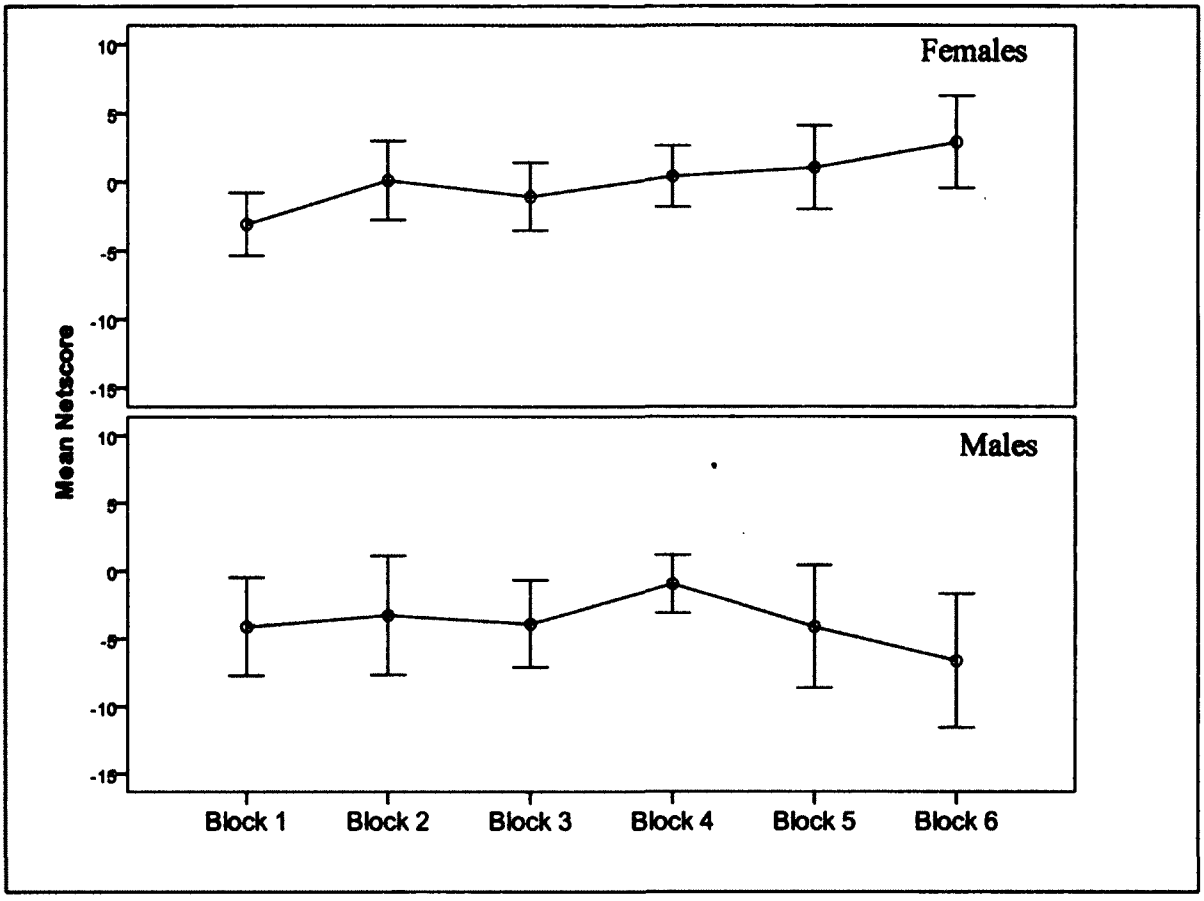

Figure 2. Mean MIGT Netscores by Block for male and female undergraduate students.

PSYCHOPATHY AND MODIFIED IGT

It was also hypothesized that there would be an interaction between WAS scores and Psychopathy on MIGT performance. Drug and alcohol abuse was also hypothesized to have a possible effect on the relationship between psychopathy and MIGT performance. The relationship between task performance, anxiety, and psychopathy was examined using two repeated measures General Linear Models (GLM). Dependent variables (DVs) for the MIGT included Netscores in each Block (of the six total Blocks). Change by Block was treated as the repeated measures factor, and this was done two ways. First, over the whole MIGT (Block 1 to Block 6), and second from Block 2 to Block 5. Psychopathy (PCL:SV scores) and anxiety (WAS scores) were treated as continuous independent variables (IVs) and the interaction of the two was included in each model. Drug and Alcohol Abuse (MAST / DAST scores) was also included in the repeated measures GLMs as covariates[5].

The GLM did not yield any significant effect of psychopathy on performance across Blocks of the MIGT, with the additional control for Drug and Alcohol Use (DAST / MAST scores), and Sex. Anxiety (WAS scores) did not yield a main effect on MIGT performance across Blocks, or a significant interaction between Anxiety and Psychopathy[6]. Table 7 displays the GLM model summary.

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[5] All analyses were conducted using PASW Statistics 18, Release Version 18.0.0 (SPSS, Inc., 2009, Chicago, IL, www.spss.com).

[6] The extent to which deck selection strategy might have yielded differential winnings on the task rather than advantageous deck selections was examined. A GLM similar to that reported here was calculated using mean points earned by Block. No significant or main effects were found based on mean points in the task.

Table 7

Model Summary for GLM with Psychopathy, Anxiety, Drug and Alcohol Abuse, Gender, and Trend Effect Across MIGT Blocks (1-6)

Effect	λ	*F*	*Df1*	*Df2*	*p*	η^2
Block (Block 1 - Block 6)	.96	.45	5	54	.81	.04
Block x DAST	.98	.24	5	54	.95	.02
Block x MAST	.99	.14	5	54	.98	.01
Block x Sex	.90	1.27	5	54	.29	.11
Block x Psychopathy (Continuous)	.97	.30	5	54	.91	.03
Block x WAS	.95	.61	5	54	.69	.05
Block x WAS x Psychopathy	.99	.07	5	54	1.00	.01

Note. Psychopathy = Psychopathy Checklist: Screening Version; WAS = Welsh Anxiety Scale; DAST = Drug Abuse Screening Test; MAST = Michigan Alcohol Screening Test; η^2 = estimated effect size for multivariate effect in this GLM model; λ = Wilks' Lambda; n = 65 (19 males, 46 females).

To examine differences in adapting to the reversal of deck contingencies between the first and second half of the MIGT, a GLM with a repeated measures factor (Block 3 / Block 6) was calculated. All other variables remain the same as the GLM described above. Results are displayed in Table 8. The only effect found was a significant Block (3/6) by Gender interaction, $F(1,58) = 4.26, p < .05$. Female undergraduate students linearly increased in performance from Block 3 to Block 6, whereas male undergraduate students declined in performance in a linear fashion.

Table 8

Model Summary for GLM with Psychopathy, Anxiety, Drug and Alcohol Abuse, Sex, and Trend Effect Across MIGT Blocks (3/6)

Effect	λ	*F*	*Df1*	*Df2*	*p*	η^2
Block (Block 3 / Block 6)	1.00	.01	1	58	.93	.00
Block x DAST	.99	.66	1	58	.42	.01
Block x MAST	1.00	.01	1	58	.95	.00
Block x Gender	.93	4.26	1	58	.04	.07
Block x Psychopathy (Continuous)	.99	.22	1	58	.65	.01
Block x WAS	1.00	.02	1	58	.88	.00
Block x WAS x Psychopathy	1.00	.07	1	58	.80	.00

Note. Psychopathy = Psychopathy Checklist: Screening version; WAS = Welsh Anxiety Scale; DAST = Drug Abuse Screening Test; MAST = Michigan Alcohol Screening Test; η^2 = estimated effect size for multivariate effect in this GLM model; λ = Wilks' Lambda; n = 65 (19 males, 46 females).

Physiological Responses

Overall undergraduates displayed very little difference in physiological responses between deck selections. Means and standard deviations for physiological responses are displayed in Table 9 as well as differences between male and female undergraduates. None of the physiological measures differed significantly between male and female undergraduates.

Table 9

Physiological Responses in Anticipation of, and Following Deck (Advantageous / Disadvantageous) Selection for Undergraduates and by Sex

	Total		*Females*		*Males*			
Measure	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*
SCR								
Appraisal								
Advantageous	.800	.017	.801	.017	.800	.016	.01	.93
Disadvantageous	.800	.016	.801	.018	.797	.014	.80	.37
Anticipatory								
Advantageous	.810	.020	.811	.022	.810	.015	.34	.57
Disadvantageous	.809	.021	.810	.022	.810	.018	.94	.34
HR								
Appraisal								
Advantageous	76.38	9.87	76.00	9.47	77.27	11.00	.19	.66
Disadvantageous	76.43	9.21	76.92	9.36	75.14	8.97	.45	.50
Anticipatory								
Advantageous	74.33	9.38	75.29	9.34	71.92	9.28	1.69	.20
Disadvantageous	75.15	9.43	75.66	9.75	73.79	8.67	.48	.49

Note. HR = Heart Rate; SC = Skin Conductance Response in μs; Advantageous / Disadvantageous = selections from advantageous / disadvantageous decks; Anticipatory / Appraisal = Responses prior to deck selection / after results are displayed to participants; $n = 65$ (19 males, 46 females).

The relationship between anxiety, drug, and alcohol abuse and physiological responses to deck selections was also explored. no significant relationship was found. Results are displayed in Table 10.

Table 10

Bivariate Correlations Between WAS, DAST, and MAST scores with Physiological Responses Prior to, and Following Selections From Advantageous and Disadvantageous Decks

Variable			*WAS*	*MAST*	*DAST*
Advantageous	Anticipatory	HR	.19	.15	.19
		SCR	-.04	-.03	-.01
	Appraisal	HR	.15	.03	.16
		SCR	.07	.12	.18
Disadvantageous	Anticipatory	HR	.09	.10	.21
		SCR	.01	-.02	-.03
	Appraisal	HR	.21	.16	.19
		SCR	.01	.05	.05

Note. WAS = Welsh Anxiety Scale; DAST = Drug Abuse Screening Test; MAST = Michigan Alcohol Screening Test; Advantageous = Selection from an advantageous deck during the MIGT; HR = Heart Rate; SCR = Skin Conductance Response; Advantageous / Disadvantageous = selections from advantageous / disadvantageous decks; Anticipatory / Appraisal = Responses prior to deck selection / after results are displayed to participants.
* $p < .05$

PSYCHOPATHY AND MODIFIED IGT

It was hypothesized that SCR responses would differentially correlate with psychopathy, specifically that Facet 1(Interpersonal) and Facet 2 (Affective) would inversely correlate with anticipatory SCR responses to disadvantageous decks, and that Facet 3 (Lifestyle) and Facet 4 (Antisocial) would positively correlate with SCR appraisal responses to disadvantageous deck selections. Pearson product-moment bivariate correlations were also calculated between physiological responses and Psychopathy (PCL:SV total or Facet scores) to determine if the construct of Psychopathy as whole or correlated sub-factors were significantly related to physiological responses to deck selections in undergraduate students. Correlations are displayed in Table 11.

Table 11

Bivariate Correlations Between PCL:SV Total and Facet Scores with Physiological Responses Prior to, and Following Selections From Advantageous and Disadvantageous Decks Across Total Sample

Variable			*Total*	*Facet 1*	*Facet 2*	*Facet 3*	*Facet 4*
Advantageous	Anticipatory	HR	-.03	.07	-.11	-.05	-.05
		SCR	.03	-.02	.06	.11	-.02
	Appraisal	HR	-.05	-.07	-.18	.01	.04
		SCR	.13	.03	.14	.38	.24
Disadvantageous	Anticipatory	HR	-.07	.11	-.16	-.10	-.11
		SCR	.02	-.03	.07	.06	-.01
	Appraisal	HR	.11	.20	.01	.04	.07
		SCR	.04	-.07	.13	.01	.01

Note. Advantageous = Selection from an advantageous deck during the MIGT; HR = Heart Rate; SCR = Skin Conductance Response; Advantageous / Disadvantageous = selections from advantageous / disadvantageous decks; Anticipatory / Appraisal = Responses prior to deck selection / after results are displayed to participants.
* $p < .05$

There were no significant correlations between psychopathy (PCL:SV total and Facet scores) for the undergraduate sample as a whole (see Table 11) or for female students (see Table 12). In male students a number of significant relations between PCL:SV total scores and Facet 2, 3, and 4 scores, and SCR responses were found. These findings are summarized in Table 13. Specifically, PCL:SV total scores were significantly positively correlated with anticipatory and appraisal responses to both advantageous and disadvantageous decks (i.e., all SCR responses). Facet 2 (Affective) of the PCL:SV was significantly positively correlated with SCRs to all deck selections with the exception of appraisal SCRs. Facet 3 (Lifestyle) was positively correlated with anticipatory SCRs to both advantageous and disadvantageous decks. Facet 4 was significantly positively correlated with SCR appraisal responses when selecting from disadvantageous decks.

Table 12

Bivariate Correlations Between PCL:SV Total and Facet Scores with Physiological Responses Prior to, and Following Selections From Advantageous and Disadvantageous Decks for Female Undergraduates.

Variable			*Total*	*Facet 1*	*Facet 2*	*Facet 3*	*Facet 4*
Advantageous	Anticipatory	HR	-.01	.12	-.08	-.11	-.004
		SCR	-.15	-.18	-.14	-.03	-.16
	Appraisal	HR	-.08	.002	-.06	-.19	-.03
		SCR	-.02	-.06	-.005	-.011	.009
Disadvantageous	Anticipatory	HR	-.12	.07	-.19	-.20	-.12
		SCR	-.13	-.17	-.10	-.06	-.11
	Appraisal	HR	.11	.17	.05	-.02	.13
		SCR	-.12	-.16	-.02	-.11	-.08

Note. Advantageous = Selection from an advantageous deck during the MIGT; HR = Heart Rate; SCR = Skin Conductance Response; Advantageous / Disadvantageous = selections from advantageous / disadvantageous decks; Anticipatory / Appraisal = Responses prior to deck selection / after results are displayed to participants.

Table 13

Bivariate Correlations Between PCL:SV Total and Facet Scores with Physiological Responses Prior to, and Following Selections From Advantageous and Disadvantageous Decks for Male Undergraduates

Variable			*Total*	*Facet 1*	*Facet 2*	*Facet 3*	*Facet 4*
Advantageous	Anticipatory	HR	.04	.08	-.11	.21	-.06
		SCR	.56*	.41	.53*	.56*	.33
	Appraisal	HR	-.01	-.23	-.35	.36	.13
		SCR	.47*	.21	.44	.42	.44
Disadvantageous	Anticipatory	HR	.11	.24	-.08	.26	-.05
		SCR	.55*	.40	.55*	.53*	.33
	Appraisal	HR	.17	.35	-.05	.24	.001
		SCR	.56*	.22	.55*	.43	.59**

Note. Advantageous = Selection from an advantageous deck during the MIGT; HR = Heart Rate; SCR = Skin Conductance Response; Advantageous / Disadvantageous = selections from advantageous / disadvantageous decks; Anticipatory / Appraisal = Responses prior to deck selection / after results are displayed to participants.
* $p < .05$; ** $p < .01$

Summary

Overall, task performance suggested that undergraduates did not perform as well on the MIGT as previous studies using the IGT have reported (e.g., Cauffman et al., 2010). While undergraduates did demonstrate learning overall, very few managed to consistently apply this learning in both halves (trials 1-60 and 61-120) of the task. This is likely due to the truncated number of trials in each half (prior to and following contingency reversal). As a result, the trend effect across trials was not significant. Undergraduates also did not differ in their performance prior to and following contingency reversal on the MIGT.

Nevertheless, interesting differences in task performance were identified when examining MIGT Netscore by Blocks of 20 trials. Male and female undergraduates significantly differed in their Netscores on Block 6 of the MIGT, with males exhibiting lower scores. This finding is interesting given that previous studies with the standard IGT have found that males outperform females (e.g., Bolla et al., 2004).

Facet 1 (Interpersonal) of the PCL:SV was inversely related to Netscore in Block 2 for male undergraduates suggesting the social/dominance elements of psychopathy predicted poor early migration to advantageous decks on the MIGT in male students. This is consistent with a recent study examining the relationship between IGT performance and psychopathy in undergraduate students which also only found a relationship between psychopathy and IGT performance in males (Morgan et al., 2011). The authors suggested that observed sex differences may reflect differences in risky impulsivity in males.

No relationships were found between HR responses and psychopathy in the undergraduate sample. Significant relationships between psychopathy and SCR responses were only found with male undergraduates. However, only one finding was consistent with

predictions, which was that in male undergraduates Facet 4 significantly predicted increased SCR appraisal responses to disadvantageous decks. While all remaining SCRs were not in the expected direction, these findings are still consistent with psychopathy being associated with differential somatic markers. It has been argued by Bechara and colleagues (2005) that somatic markers do not always increase or decrease in keeping with expectation. The key factor is that they were present (suggesting an intact VMPFC) and positive (suggesting psychopathy is associated with differential somatic markers in undergraduate males). Why this is the case in males and not females is not clear.

Study 2

Hypotheses

Based on previous research with incarcerated offenders (Blair & Cipolotti, 2000; Blair et al., 2001; Mitchell et al., 2002) it was hypothesized that offenders higher in psychopathy would exhibit poorer performance on the MIGT relative to controls. Research by Schmitt et al. (1999) found an interaction between anxiety and IGT task performance in an offender sample. It was hypothesized that anxiety would have an impact on MIGT task performance with high-anxious offenders performing better on the MIGT than low-anxious offenders. Given other previous works arguing the value of further subdividing psychopathy groups on the basis of anxiety (e.g., Schmitt & Newman, 1999) it was further hypothesized that there would be a significant interaction between psychopathy and anxiety (WAS scores) with low-anxious psychopathic offenders performing more poorly than high-anxious psychopathic offenders.

Given the potential that drug and alcohol abuse can have an impact on IGT performance (Verdejo-Garcia et al., 2007) it was hypothesized that controlling for drug and alcohol abuse

(MAST / DAST scores) may weaken the magnitude of the effect of psychopathy on MIGT performance.

It was also hypothesized that psychopathic offenders would exhibit differential autonomic reactivity to disadvantageous deck selections relative to non-psychopathic offenders. In the face of disadvantageous deck selections psychopathic offenders would display lower SCR responses that non-psychopathic offenders. Psychopathic offenders would also display increased HR responses to outcomes on disadvantageous decks. Reduced anticipatory SCRs and increased HR would be congruent with previous laboratory research with psychopaths (e.g., Ogloff & Wong, 1990). Decreased SCRs would also be consistent with a putative somatic marker deficit in psychopaths (Bechara et al., 2005). Specifically, psychopathic offenders would display deficient SCR responses that the SMH would suggest are necessary for learning and updating card selection strategies.

Method

Participants

Offenders were recruited from three Canadian correctional facilities housing offenders in remand or serving sentences of two years or less. Offenders were recruited using sign-up sheets posted in common areas on their living units or ranges. Offenders were eligible to participate in the study if their institutional file did not indicate they were suffering from a major mental illness or had suffered severe brain trauma. Offenders over the age of 60 were also excluded from the study.

Seventy-two male offender participants volunteered to participate in the study with ages ranging from 18 to 68. Two offenders were excluded from the study based on age (greater than 60 years old), three were excluded based on their suffering from serious mental illness or brain

trauma. The remaining 67 offenders ranged in age from 18-56 (M = 33.22, SD = 10.17). Ethnically, offenders were 72% Caucasian, 17% Aboriginal and 7% Black, and 4% other backgrounds. Five percent of offenders had attended any post-secondary education, 16% had less than a grade nine education, and 79% had some high school education. Offenders were convicted or charged of a range of offences including: sex offences (18%), property offences (30%), violent offences (22%), and drug-related offences (30%). For twelve of the 67 offenders offence categories were based on charges as they were in pre-trial custody (remand).

Task

Identical to Study 1.

Physiological Recording and Quantification

Identical to Study 1.

Measures

Measures are identical to Study 1 with the exception of psychopathy.

Psychopathy

Psychopathy was assessed using the Psychopathy Checklist-Revised (PCL-R; Hare, 2003). The PCL-R is a 20-item rating scale shown to have good validity and reliability. The PCL-R is a 20 item clinical rating scale scored from detailed file information and a semi-structured interview. The items are scored on a 3-point scale (0 = "item does not apply". 1 = "item applies somewhat", 2 = "item definitely applies") and are summed to obtain a total score that ranges from 0 to 40. Items include a number of behavioural and interpersonal characteristics such as glibness and superficial charm, criminal versatility, and grandiose sense of self-worth. (See Table 1 for a list of items).

Items address prominent characteristics of psychopathy, such as callousness, sexual promiscuity, irresponsibility, and criminal versatility. The PCL-R was completed based on a combination of information obtained from official corrections' files, and from a detailed interview with inmates addressing childhood, relationships with family and friends, and occupational, educational, sexual, and criminal histories. Interviews took place in either the psychology office of the institution or in closed interview areas designated for programs or professional visits. One offender was not available to complete the interview portion of study, and so was scored solely based on file information. Analyses in this study used the four-facet model of the PCL-R (Hare, 2003).

Interviews were recorded, and later scored along with relevant file information by a trained research assistant to determine the level of agreement by calculating single measure ICCs. Ten percent (n = 7) of each of the offender sample was randomly selected and scored blindly by the trained research assistant. Single ICCs for PCL-R total and Facet scores were all acceptable: PCL-R Total = .91, Facet 1 = .86, Facet 2 = .82, Facet 3 = .96, and Facet 4 = .86.

The cutoff for offenders to be included in the psychopathic group in this study was a score of 25 and above on the PCL-R. This cutoff was selected rather than the recommended cutoff of 30 because only seven offenders in this study would have met the cutoff which would have limited statistical power. Psychopathy was also examined as a dimensional construct in keeping with recent research suggesting psychopathy may be seen as a dimensional construct (e.g., Guay et al., 2007).

Procedure

Offenders were provided with a briefing on the overall experiment, and asked for informed consent. If informed consent was granted, offenders were given a semi-structured

interview to be used to score the PCL-R. In addition, the offender's institutional file was reviewed. Interviews ranged from 30 to 90 minutes.

Offenders were provided with anxiety, drug and alcohol questionnaires and then, after a break, asked to participate in a computer-based gambling task. Before completing the task on a laptop brought into the prison, electrodes were attached to the participant's hand for skin conductance response, and the arm for heart rate, and leads were connected to the Coulbourn Instruments panel.

Once recordings were made, and any needed adjustments to the leads, or electrode placement, the participant was asked to follow the instructions on the computer screen and to begin when comfortable.

Following completion of the tasks, offenders were provided with a debriefing on the experiment, and thanked for their participation. No monetary compensation was provided to the offenders.

Data Screening

For all models, data were screened for univariate outliers that fell outside of three standard deviations away from the mean. Variables were examined for normality of sampling distribution, linearity, homogeneity of variance, and, in the case of mixed ANCOVA models, reliability of covariates (Tabachnick & Fidel, 2007). Screening for multivariate outliers was accomplished using Mahalanobis distance. Cases falling outside of the recommended cutoff were removed for those specific analyses.

Eleven offenders did not have viable physiological responses and they were excluded from the physiological analyses.

Results

Descriptive Statistics

Overall, PCL-R scores in this sample were lower (M = 16.82, SD = 9.41) than in many studies, including samples of offenders with personality disorders (e.g., Grann et al., 1999).

One offender (non-psychopathic) did not complete a WAS so was not included in the analysis. Offender WAS Scores were relatively high, with a mean of 18.12 (SD = 9.67). Many other psychopathy studies that include WAS as a measure in offender samples report lower mean scores between 12 and 15 (e.g., Hale et al., 2004; Zeier et al., 2009). DAST scores were also higher than other studies in Canadian offender samples (e.g., Millson & Robinson, 1992). These differences may be accounted for by the nature of two of the institutions visited (i.e., correctional facilities meant to provide additional treatment support for drug and alcohol addiction) and intermediate mental health care (i.e., offenders are mentally fit, but require additional mental health care not offered in standard jail settings). Though they did not significantly differ, means for the two treatment centres, M = 16.66, SD = 9.96, and M = 16.88, SD = 9.21, were lower than the means of the participants from the remand facility, M = 21.38, SD = 11.31, suggesting that the WAS scores from the treatment centres were not necessarily overly anxious or disturbed relative to offenders waiting to be sentenced. Table 14 displays descriptive statistics and internal consistency measures for the DAST, MAST, WAS, and PCL-R total and facet scores.

Given the wide range in ages of offenders in this sample, the ages of Psychopathic (n = 18) and Non-Psychopathic (n = 49) groups was examined. A significant difference in age was found between psychopathic and non-psychopathic offenders, $F(1,61) = 4.22$, $p < .05$, such that the psychopathic group was younger (M = 29.28, SD = 9.41) than the non-psychopathic group (M = 37.47, SD = 12.91). Research has suggested that, on a standard version of the IGT, that

younger adults (18-34) adopt a different strategy than older adults (65-88) (Wood, Busemeyer, Koling, Cox, & Davis, 2005). While the age differences in the offender sample in this study are not so extreme, given the potential for impact on group differences in task performance, age was controlled statistically in ANCOVA and GLM analyses.

Table 14

Means (M) and Standard Deviations (SD) for Psychopathy and Self-Report Scales for Offenders

Measure	*M*	*SD*	*α*
PCL-R Total	16.82	9.41	.91
Facet 1	3.00	2.42	.84
Facet 2	3.61	2.59	.85
Facet 3	4.13	2.53	.79
Facet 4	5.01	2.97	.81
DAST	16.79	12.30	.95
MAST	8.23	6.58	.93
WAS	18.12	9.67	.93

Note. PCL-R = Psychopathy Checklist-Revised; WAS = Welsh Anxiety Scale; DAST = Drug Abuse Screening Test; MAST = Michigan Alcohol Screening Test; α = Cronbach's alpha measure of internal consistency; n = 67 (18 psychopathic, 49 non-psychopathic).

Performance on the MIGT

In the offender sample 36 out of 63, or 57% of participants displayed an impaired performance on the MIGT. The proportion is slightly higher in offenders than it is in Study 2.

Based on previous research with incarcerated offenders (Blair & Cipolotti, 2000; Blair et al., 2001; Mitchell et al., 2002) it was hypothesized that offenders higher in psychopathy would exhibit poorer performance on the MIGT relative to controls. This was tested four ways. First, a series of ANOVAs conducted for each of the six Blocks (of 20 trials) comparing the Netscores of psychopathic and non-psychopathic offenders. Second, PCL-R Total and Facet scores were correlated with MIGT performance by Block. Third, the change in performance across the six Blocks was compared between psychopathic and non-psychopathic offenders using a repeated measures ANCOVA with Block performance as the dependent variable (DV), Block as the repeated measures independent variable (IV), Anxiety (High and Low) and Psychopathy (Psychopathic and Non-Psychopathic) as between-groups IVs, and MAST and DAST as covariates. This was also mirrored in a GLM model replacing Psychopathy (Psychopathic and Non-Psychopathic) with PCL-R Total score as a continuous IV. Fourth, to capture differences between groups in adapting to the reversal of deck contingencies between the first and second half of the MIGT, the repeated measures IV of Block (Blocks 1-6) was replaced with only Block 3 and Block 6.

Comparison of psychopathic and non-psychopathic Netscores by Block found that psychopathic offenders significantly differed in their scores on the MIGT at Block 2, $F(1, 65) = 5.76$, $p < .05$ from non-psychopathic offenders, with psychopathic offenders netting a lower Netscore ($M = -4.27$, $SD = 8.15$) than non-psychopathic offenders ($M = .50$, $SD = 10.24$). Table

15 displays means for Blocks 1-6 on the MIGT for total sample, psychopathic, and non-psychopathic offenders.

Table 15

Means (M) and Standard Deviations (SD) for MIGT Netscores by Block and Psychopathy in Offenders

	Offenders (n = 67)		Psychopathic (n = 18)		Non-Psychopathic (n = 49)			
MIGT	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*
Block 1	-3.51	6.47	-3.60	5.57	-3.25	8.73	.47	.49
Block 2	-3.02	8.91	-4.27	8.15	.50	10.24	5.76	.02
Block 3	-2.36	8.13	-2.36	7.96	-1.37	8.82	1.04	.31
Block 4	.62	6.91	.62	6.85	-.50	7.25	.09	.77
Block 5	-2.49	9.17	-2.49	9.81	-3.25	7.34	.48	.49
Block 6	-1.56	9.22	-1.56	9.50	-1.50	8.69	.17	.68

Note. MIGT = Modified Iowa Gambling Task; Block = Block of twenty trials; All degrees of freedom are 1,65 for all tests.

Bivariate correlations (see Table 16) between PCL-R Total and Facet scores and Netscores by Block on the MIGT yielded significant positive correlations between PCL-R Total score and mean Netscore in Block 1 ($r = .31, p < .05$) and Block 2 ($r = .29, p < .05$). This suggested that PCL-R Total score predicted an improved performance in the first two blocks of the MIGT. Facet 1 (Interpersonal) scores also significantly predicted improvements in MIGT performance in Block 2 ($r = .33, p < .01$) and Block 3 ($r = .24, p < .05$).

Table 16

Bivariate Correlations Between PCL-R Total and Facet Scores for Offenders

Measure	Block 1	Block 2	Block 3	Block 4	Block 5	Block 6
			Total Sample			
PCL-R Total	.31*	.29*	.05	-.12	-.13	-.08
Facet 1	.13	.33**	.24*	-.21	-.20	-.06
Facet 2	.04	.24	.08	-.04	.00	-.02
Facet 3	.13	.13	.03	-.09	-.17	-.21
Facet4	.17	.12	.03	.05	-.04	-.20

Note. Block = Block of 20 trials on the MIGT; $n = 67$.
* $p < .05$; ** $p < .01$

PSYCHOPATHY AND MODIFIED IGT

The relationship between anxiety, drug, and alcohol abuse and MIGT performance was also explored. There were no significant bivariate correlations between MAST, DAST, and WAS scores and MIGT performance by Block. Results are displayed in Table 17.

Table 17

Bivariate Correlations Between MIGT Task performance, WAS, MAST, and DAST scores for Undergraduates

Variable	*WAS*	*MAST*	*DAST*
Block 1	.03	.05	.21
Block 2	.18	.17	.16
Block 3	.20	.14	.15
Block 4	-.15	-.02	-.16
Block 5	.10	.04	.05
Block 6	.04	-.16	-.10

Note. Block = Block of 20 trials on the MIGT; $n = 67$; WAS = Welsh Anxiety Scale; DAST = Drug Abuse Screening Test; MAST = Michigan Alcohol Screening Test.
* $p < .05$

Changes in performance across the six Blocks of MIGT Netscores were compared between psychopathic and non-psychopathic offenders using a repeated measures ANCOVA. No significant main effects were found for Psychopathy (Psychopathic and Non-Psychopathic), Block (Block 1 – Block 6) or covariates (Age, DAST score, or MAST score). Nor was the hypothesized relationship found between Anxiety and MIGT performance by Block or the interaction between Psychopathy and Anxiety. Table 18 displays a model summary of the results of this analysis. Figure 3 presents mean Netscores for each Psychopathy group (Psychopathic and Non-Psychopathic) across Blocks.

Table 18

Model Summary for Repeated Measures ANCOVA with Psychopathy, Anxiety, Drug and Alcohol Abuse, Age, and Trend Effect Across MIGT Blocks (1-6)

Effect	λ	*F*	*Df1*	*Df2*	*p*	η^2
Block (Block 1 - Block 6)	.88	1.41	5	50	.24	.12
Block x DAST	.95	.63	5	50	.68	.06
Block x MAST	.89	1.20	5	50	.32	.11
Block x Age	.94	.63	5	50	.68	.06
Block x Psychopathy	.86	1.65	5	50	.16	.14
Block x WAS	.91	1.00	5	50	.43	.09
Block x WAS x Psychopathy	.95	.51	5	50	.77	.05

Note. Psychopathy = Psychopathy Checklist – Revised; WAS = Welsh Anxiety Scale; DAST = Drug Abuse Screening Test; MAST = Michigan Alcohol Screening Testing; η^2 = estimated effect size for multivariate effect in this ANCOVA model; λ = Wilks' Lambda, *n* = 67 (18 Psychopathic, 49 Non-Psychopathic).

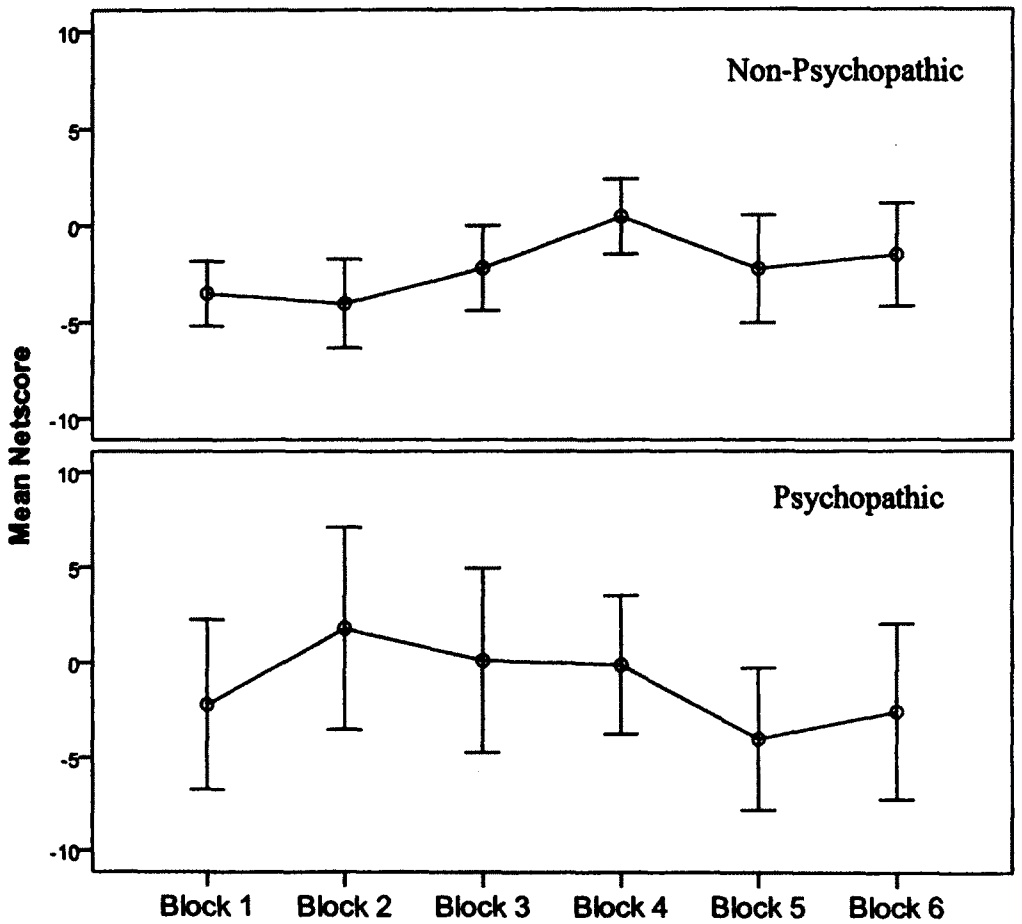

Figure 3. Mean Netscore by Block of 20 Trials in the MIGT by Psychopathy Group (Psychopathic/Non-psychopathic). Bars represent standard error of the mean

Changes in performance between Block 3 and Block 6 of MIGT Netscores were also compared between psychopathic and non-psychopathic offenders using a repeated measures ANCOVA. No significant interactions or main effects were found. Table 19 displays a model summary for the repeated measures ANCOVA.

Table 19

Model Summary for Repeated Measures ANCOVA with Psychopathy, Anxiety, Drug and Alcohol Abuse, Age, and Trend Effect Across MIGT Block 3 and Block 6.

Effect	λ	*F*	*Df1*	*Df2*	*p*	η^2
Block (Block 3 / Block 6)	.94	3.49	1	54	.07	.06
Block x DAST	.99	.60	1	54	.44	.01
Block x MAST	.96	2.41	1	54	.13	.04
Block x Age	.98	1.35	1	54	.25	.02
Block x Psychopathy	.99	.37	1	54	.54	.01
Block x WAS x Psychopathy	1.00	.00	1	54	.95	.01

Note. Psychopathy = Psychopathy Checklist – Revised; WAS = Welsh Anxiety Scale; DAST = Drug Abuse Screening Test; MAST = Michigan Alcohol Screening Testing; η^2 = estimated effect size for multivariate effect in this ANCOVA model; λ = Wilks' Lambda, n = 67 (18 Psychopathic, 49 Non-Psychopathic).

Psychopathy as a Continuous Variable

PCL-R total scores were used as a continuous variable in GLM models. All other variables in the model are identical to those listed above. In the first GLM model, summarized in Table 20 the repeated measures IV was change over Blocks 1-6 of the MIGT. The main effect of Block was significant, $F(5,50) = 2.76, p <. 05$. Netscores increased linearly overall over the duration of the MIGT (Table 13 displays means for all offenders over Blocks). A significant interaction between Psychopathy (PCL-R Total score) and Block was also found $F(5,50) = 2.89$, $p < .05$, reflecting a linear decrease in performance as a function of psychopathy. No other significant main effects or interaction were found[7].

[7] The extent to which deck selection strategy might have yielded differential winnings on the task rather than advantageous deck selections was examined. An ANCOVA and GLM similar to those reported here were calculated using mean points earned by Block. No significant or main effects were found based on mean points in the task.

Table 20

Model Summary for Repeated Measures GLM with Psychopathy, Anxiety, Drug and Alcohol Abuse, Age, and Trend Effect Across MIGT Blocks (1-6)

Effect	λ	*F*	*Df1*	*Df2*	*p*	η^2
Block (Block 1 - Block 6)	.78	2.76	5	50	.03	.22
Block x DAST	.95	.52	5	50	.76	.05
Block x MAST	.91	1.01	5	50	.42	.09
Block x Age	.93	.73	5	50	.61	.07
Block x Psychopathy (Total Score)	.78	2.89	5	50	.02	.22
Block x WAS	.93	.74	5	50	.60	.07
Block x WAS x Psychopathy	.93	.74	5	50	.40	.01

Note. Psychopathy = Psychopathy Checklist – Revised; WAS = Welsh Anxiety Scale; DAST = Drug Abuse Screening Test; MAST = Michigan Alcohol Screening Testing; η^2 = estimated effect size for multivariate effect in this GLM model; λ = Wilks' Lambda, *n* = 67 (18 Psychopathic, 49 Non-Psychopathic).

Another similar GLM model was calculated, but with change in MIGT Netscore from Block 3 and Block 6 as the repeated measures IV. No significant main effects or interactions were found. Table 21 displays the model summary for this analysis.

Table 21

Model Summary for Repeated Measures GLM with Psychopathy, Anxiety, Drug and Alcohol Abuse, Age, and Trend Effect from Block 3 to Block 6

Effect	λ	*F*	*Df1*	*Df2*	*p*	η^2
Block (Block 3 / Block 6)	.94	1.89	1	54	.18	.03
Block x DAST	.99	.53	1	54	.47	.01
Block x MAST	.97	1.89	1	54	.17	.03
Block x Age	.98	1.13	1	54	.29	.02
Block x Psychopathy (Total Score)	1.00	.02	1	54	.90	.00
Block x WAS	.98	1.02	1	54	.32	.02
Block x WAS x Psychopathy	.98	.96	1	54	.33	.02

Note. Psychopathy = Psychopathy Checklist – Revised; WAS = Welsh Anxiety Scale; DAST = Drug Abuse Screening Test; MAST = Michigan Alcohol Screening Testing; η^2 = estimated effect size for multivariate effect in this GLM model; λ = Wilks' Lambda, n = 67 (18 Psychopathic, 49 Non-Psychopathic).

Physiological Responses

Overall, there were very few differences in offender physiological responses in anticipation of and following selections from decks, whether the decks were advantageous or disadvantageous. Psychopathic offenders differed from non-psychopathic offenders in their SCR responses to selections from advantageous decks, $F(1,52) = 4.55, p < .05$. Psychopathic offenders displayed increased SCR responses ($M = .801$, $SD = .011$) relative to non-psychopathic offenders (M = .797, $SD = .009$). This finding does not support study hypotheses for psychopathic offenders. Results are displayed in Table 22.

Table 22

Physiological Responses in Anticipation of, and Following Deck (Advantageous / Disadvantageous) Selection for Offenders Overall and by Psychopathy

	Offenders (n = 67)		Psychopathic (n = 18)		Non-Psychopathic (n = 49)			
Measure	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*
SCR								
Appraisal								
Advantageous	.797	.008	.801	.01	.801	.795	4.55	<.05
Disadvantageous	.798	.008	.801	.011	.801	.801	2.14	ns
Anticipatory								
Advantageous	.797	.01	0.80	.01	.801	.013	3.30	ns
Disadvantageous	.796	.01	0.80	.01	.799	.011	1.25	ns
HR								
Appraisal								
Advantageous	75.56	9.56	74.69	8.05	75.79	9.99	0.11	ns
Disadvantageous	75.43	9.38	75.57	7.70	75.39	9.86	0.003	ns
Anticipatory								
Advantageous	76.83	10.13	77.17	8.74	77.08	10.51	0.001	ns
Disadvantageous	76.83	10.22	77.18	8.74	77.08	10.51	0.13	ns

Note. HR = Heart Rate; SC = Skin Conductance Response in µs; Advantageous / Disadvantageous = selections from advantageous / disadvantageous decks; Anticipatory / Appraisal = Responses prior to deck selection / after results are displayed to participants; n = 67 (18 Psychopathic, 49 Non-Psychopathic).

It was also hypothesized that SCR responses would differentially correlate with psychopathy, such that PCL-R Total scores would predict decreased SCR responses relative to non-psychopathic offenders in anticipation of disadvantageous decks as well as increased HR. Evidence was not found with respect to the hypothesized differential physiological response to deck type as a function of psychopathy. There were no significant correlations between PCL-R Total score and SCR/HR measures. Also, hypothesized specific relationships between PCL-R Facet scores were not supported. But there were a number of unexpected significant relationships found between SCR/HR and PCL-R Facet scores. First, HR in anticipation of selecting from advantageous decks decreased as a function of PCL-R Total and Facet 1 (Interpersonal) scores, with $r = -.31, p <. 05$ and $r = -.38, p < .01$ for Total and Facet 1, respectively. Similarly, Total and Facet 1 (Interpersonal) scores also predicted decreased HR in anticipation of making selections from disadvantageous decks with $r = -.32, p < .05$, and $r = -.37, p < .05$ respectively. This suggests that the traits associated with manipulative interpersonal style (among other similar traits) of the PCL-R may reflect an orienting response to the outcomes of deck selections. SCR response to the outcomes of selecting (Appraisal) from advantageous decks increased as a function of Facet 2 (Affective) of the PCL-R, $r = .31, p <. 05$. This suggests that traits such as a lack of empathy on the PCL-R may be associated with increased physiological response to decks with better long-term outcomes. Table 23 displays all psychopathy / physiological response correlations.

Table 23

Bivariate Correlations between PCL-R Total and Facet Scores with Physiological Responses Prior to and Following Selections from Advantageous and Disadvantageous Decks in Offenders

Variable			*Total*	*Facet 1*	*Facet 2*	*Facet 3*	*Facet 4*
Advantageous	Anticipatory	HR	-.31*	-.38**	-.23	-.11	-.17
		SCR	.15	.12	.17	.12	.02
	Appraisal	HR	-.07	-.18	.01	.04	-.05
		SCR	.22	.19	.31*	.20	.08
Disadvantageous	Anticipatory	HR	-.32*	-.37*	-.23	-.13	-.22
		SCR	.08	.15	.27	.26	.14
	Appraisal	HR	-.25	-.32	-.14	-.05	-.08
		SCR	.11	.06	.20	.07	-.05

Note. HR = Heart Rate; SC = Skin Conductance Response in μs; Advantageous / Disadvantageous = selections from advantageous / disadvantageous decks; Anticipatory / Appraisal = Responses prior to deck selection / after results are displayed to participants; $n = 67$.
* $p < .05$; ** $p < .01$

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Evidence was not found with respect to differential physiological response to deck type as a function anxiety, drug, or alcohol abuse. No significant correlations between WAS, DAST, and MAST scores and SCR/HR measures. Results are displayed in Table 24.

Table 24

Bivariate Correlations Between WAS, DAST, and MAST scores with Physiological Responses Prior to, and Following Selections From Advantageous and Disadvantageous Decks Across Total Sample

Variable			*WAS*	*MAST*	*DAST*
Advantageous	Anticipatory	HR	.03	-.15	-.03
		SCR	-.09	-.02	.02
	Appraisal	HR	-.01	-.14	.01
		SCR	-.07	-.04	-.03
Disadvantageous	Anticipatory	HR	-.03	-.15	-.09
		SCR	-.04	-.09	-.02
	Appraisal	HR	-.03	-.10	.07
		SCR	.02	-.11	-.05

Note. WAS = Welsh Anxiety Scale; DAST = Drug Abuse Screening Test; MAST = Michigan Alcohol Screening Test; Advantageous = Selection from an advantageous deck during the MIGT; HR = Heart Rate; SCR = Skin Conductance Response; Advantageous / Disadvantageous = selections from advantageous / disadvantageous decks; Anticipatory / Appraisal = Responses prior to deck selection / after results are displayed to participants; $n = 67$.
* $p < .05$

Summary

Overall, the hypothesis relating to poorer MIGT performance in psychopathic offenders as compared to controls was only partially supported. Group differences were observed when examining changes in Block Netscores across the task. An interaction between Netscores by Block and Psychopathy was only observed when Psychopathy was treated as a continuous variable. Specific correlations between task performance and psychopathy were found with respect to Blocks 1-3.

In this sample, given that the overall mean was lower for psychopathy than in some other offender samples (e.g., Grann et al., 1997) and there were very few offenders scoring above the recommended cutoff for incarcerated offenders, the dimension approach yielded more consistent results with respect to MIGT performance over separating the sample based on a cutoff of 25.

That there was no interaction between psychopathy and anxiety may have been due to the overall high mean of anxiety in this study relative to other studies (e.g., Hale et al., 2009; Zeier et al., 2009).

That PCL-R Total score increased positive performance in the initial Blocks (1-2) as did Facet 1 (Interpersonal) in the first half of the MIGT (Blocks 1-3) suggests that the interpersonal dimension of psychopathy may provide offenders with an advantage in making decisions under ambiguity. This unexpected finding reflects a relationship between traits such as deceitfulness and acquiring the initial underlying contingencies in the MIGT. This then makes some sense, given that the standard IGT (to which the MIGT may be directly compared within the first 60 trials) was designed to approximate social decision-making.

Physiological results demonstrated HR decreases in anticipation of deck selections as a function of PCL-R Facet 1 (Interpersonal) and Facet 2 (Affective) and SCR increase in appraisal

to advantageous decks as a function of PCL-R Facet 3 (Lifestyle) score. While HR results may reflect an orienting response, the SCR finding may be explained in terms of deck selection results. On each trial, participants are shown a running tally of their winnings in addition to the gain and loss for that trial. It is possible that SCR responses to appraisal on advantageous decks reflect excitement as winnings increase.

Initial improvement in MIGT performance may reflect a short-term advantage in social situations associated with Facet 1 of the PCL-R. Deceitfulness, while it may prove disadvantageous in the long-term, often has immediate benefits.

Findings related to HR responses and the relationship found between Facet 1 (Interpersonal) and Facet 2 (Affective) may relate to a difference in this task relative to many other cognitive tasks used with psychopathic offender samples. The MIGT is a game. There are gains and losses, and participants can accrue points. Psychopathy, particularly Facets 1 and 2 may be associated with enjoyment of the game and attention paid to the task while playing.

Discussion

This dissertation sought to examine the extent to which psychopathy predicts impaired decision making on a modified version of the IGT. The modified version of the IGT in this study was designed to increase the need for participants to engage in reversal learning. Overall performance was examined on the task as a measure of how well participants learned to avoid disadvantageous decks and select from advantageous decks across Blocks of trials (20 trials per Block). Change in participant performance on the task was also measured prior to, and after, deck contingencies were reversed (i.e., Blocks 3 and 6). The study also collected physiological responses (HR, SCR) while participants engaged in the task. This was done to address a paucity of research examining the relationship between physiological responses during decision-making

tasks and psychopathy. In order to examine potential different manifestations of psychopathic traits in offender and university student samples, this dissertation was divided into two studies. One study was conducted with university students and the second with offenders. In both, psychopathy was treated as a dimensional construct. In the second study with offenders psychopathy was also examined as a discrete classification. To allow for the potential that correlated factors may differentially relate to performance on the MIGT as well as physiological responses, PCL:SV and PCL-R (in Study 1 and Study 2, respectively) Facet scores were correlated with MIGT performance and physiological responses. Further, to acknowledge an impressive and growing body of research by Newman and colleagues indicating that important findings regarding information processing may emerge based on the interaction between psychopathy and anxiety, this interaction was examined in both studies. Finally, given mixed findings in the literature regarding the impact on IGT performance by drug and alcohol addiction, and with frontal lobe function, MAST and DAST scores were included as covariates in an attempt to statistically control for the influence of these variables on task performance.

Results of Study 1 found that in this undergraduate student sample there was no evidence that psychopathy, as measured by the PCL:SV, predicted performance deficits on the MIGT.

In the offender sample there was a significant positive correlation with Facet 1 (Interpersonal) of the PCL:SV at Block 2 of the MIGT. If Facet 1 predicts enhanced performance on a social decision-making game, it may be that the manifestation of this trait is adaptive in offender samples. The Interpersonal facet (Facet 1) of the PCL:SV comprises superficial, grandiose, and deceitful traits, and may very reasonably be considered useful in social decision-making.

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In Study 2, a significant interaction between psychopathy and Netscore trend across Blocks was found in keeping with Blair et al. (2001) and Mitchell et al. (2002). However, this only applied when psychopathy was treated as a continuous variable. There were two task design features that might be useful in reconciling the contradictory results. First, in this study, much like Mitchell et al. (2002), there was a pause. Though in the Mitchell study the pause was much shorter (1s) than the pause in the current study (2s before presentation, 6s following presentation). Newman and colleagues (1987) previously demonstrated that forced pauses can remedy psychopaths' poor behavioural inhibition. The six second pause displaying card selection results (intended to ensure full appraisal SCR responses) may have allowed psychopathic offenders to overcome a preference for higher gain (reward) decks. This might explain the initial positive relationship between psychopathy and task performance, but lack of group differences when comparing psychopathic and non-psychopathic offenders. Second, unlike Schmitt et al. (1999) and Lösel and Schmucker (2004), there were no incentives for offenders in this study. Conversely, in Study 1, participants were given class credit and paid for participation. In Schmitt et al. (1999) offenders received small amounts of real money based on game play. In prison, small amounts of money can have considerable value. In Lösel and Schmucker (2004), a reward was given to the best performers on the IGT. These incentives may have pushed offenders to try harder and thereby improved their scores on the IGT thereby reducing observed differences in task performance between psychopathic and non-psychopathic groups. Hare (1984) provided participants with a monetary incentive for participation and also promised additional monetary reward based on high performance on a set of neurocognitive tests indexing frontal lobe function. While the impact of incentive on task performance was not directly examined, offenders did perform as well as controls on the many of the cognitive tests (Hare, 1984). The

effect of linking task performance to incentive on tasks requiring frontal lobe function may be considered as an area for further study. In the current context there was no strong evidence that participants were not engaged in the task. Almost all students that participated in the task completed all 120 trials.

The current study employed a modified version of the IGT that enhanced an existing capacity of the IGT (c.f., Dunn, 2006) to require reversal learning. The significant interaction between psychopathy when treated as a continuous variable and Netscores by Block in this study is consistent with previous research suggesting impaired response reversal in psychopathic offenders (Mitchell et al., 2002).

However, that change in Netscores from Block 3 and Block 6 in both Study 1 and Study 2 did not yield significant results may reflect a limitation in the design of the task used in this study. In most reversal learning tasks, reversal of contingencies only takes place once participants have demonstrated that they have mastered initial contingencies. It is possible that comparisons of performance between Blocks 3 and 6 of the MIGT may not measure reversal learning *per se*, but instead a persistent inability to learn to avoid disadvantageous decks. A possible way to mitigate against this in future studies would be to change contingencies after a participant has made a set number of advantageous deck selections, thereby demonstrating mastery of initial contingencies.

That drug and alcohol abuse did not a) yield significant main effects in reported analyses of variance, or b) significantly reduce the effect of psychopathy on MIGT performance suggests that observed deficits in IGT performance by psychopathic offenders are not solely due to drug and alcohol abuse. However, this finding must be tempered with the fact that the MAST and DAST measures of drug and alcohol abuse used in this test were designed for screening for

active drug and alcohol abuse behaviour. While a number of offenders included in the study were chronic drug and / or alcohol abusers over the lifespan, being in a secure environment, and potentially receiving some form of treatment, may have influenced their scores on the measures of drug and alcohol abuse in this study, and thereby limited findings regarding the possible impact that drug / alcohol abuse may have had on task performance. Research has found that lifespan drug use can impair performance on the IGT (Barry & Petry, 2008). However, the DAST and the MAST would only have provided statistical control for those offenders recently abusing substances or acutely experiencing withdrawal symptoms.

The expected interaction between psychopathy and anxiety was not supported, in either Study 1 or Study 2. This runs contrary to previous research conducted by Newman and colleagues demonstrating that anxiety and psychopathy interact in meaningful ways particularly with respect to the difference in performance between low- and high-anxious psychopaths on a number of cognitive tasks (for a review see Hiatt & Newman, 2006). More specifically, this finding runs contrary to Schmitt et al. (1999) where a relationship was found between anxiety and IGT performance in offenders. That no main effects for anxiety were found in the study is also surprising given that trait anxiety has been found to be associated with anticipation of threat in psychopathic offenders (Lake et al., 2011) and comparison samples (Endler & Kocovski, 2001; Spielberger, 1966) and associated with preferential processing of aversive stimuli (Calvo et al., 2003). While not a central question in this study, previous research has suggested high trait anxiety (though not measured using the WAS) is associated with impaired decision-making in IGT, and that impaired performance is independent of increased anticipatory SCRs and increased HR deceleration (Miu et al., 2008). Given that the MIGT used in this study had a relatively short window for top-down control (i.e., fewer trials where participants were likely to have conscious

awareness of task contingencies) the role of somatic markers may have been emphasized, and, as Miu and colleagues (2008) observed, somatic makers in high-anxiety participants is not predictive of poor performance.

In Study 1, significant differences were found between males and females on MIGT performance. This finding runs contrary to expectation given previous research indicating that males outperform females on the standard IGT. However, two factors may have influenced this finding. First, the age of the undergraduate students may play a role insofar as males may have differential maturation rates in the brain regions implicated by previous research, such as the VMPFC (Cowell et al., 1994), studies have demonstrated differential maturation periods (Baena et al., 2010; Gogtay et al., 2004; Segalowitz & Davies, 2004) with respect to the VMPFC relative to other frontal regions. However, evidence for specific differential VMPFC maturation periods between males and females has been not been cited. It may also be the case that the response reversal element of the MIGT was due to another participant characteristic not measured in this study such as impulsivity. Previous studies have demonstrated that high impulsivity predicts impaired response reversal in healthy participants (Franken, van Stein, Nijs, & Muris, 2008). Studies have also demonstrated that high levels of education can have a paradoxical effect on IGT performance such that at higher levels performance may actually decline (Evans, Kemish, & Turnbull, 2004). Based on research with exclusively female participants, it has been suggested that highly educated participants are more likely to "over-ride" emotional signals stemming from somatic markers at later stages of the task (Evans et al., 2004). The relationship between sex and high levels of education is yet to be fully examined in the IGT literature, however, a possible relationship between sex differences in VMPFC development, and somatic markers may be

worthy of further study. With regard to level of education, the samples in the two different studies were of vastly different (with only a few exceptions) educational backgrounds.

Previous studies in undergraduate students have found differences in cardiac responding to unpleasant stimuli between students high in psychopathic traits versus students low in psychopathic traits (Osumi, Shimazaki, Imai, Sugiura, & Ohira, 2007), in electrodermal hyporeactivity in students high in emotional detachment (defined by SRP-II subscale scores) to emotional vignettes (Bare, Hopko, & Armento, 2004), and differential skin conductance responses to anticipated loud noises (Dindo & Fowles, 2011), and while giving an unpleasant speech (Dindo & Fowles, 2011). The lack of results in this study may be explained in terms of the task requirement. While students were presented with losses during the task, the losses were avoidable by shifting decks. In forensic samples, avoidable threat has been found not to have the same impact on autonomic responses as unavoidable threat (e.g., Ogloff & Wong, 1990). Further, previous studies indexing SCR and HR responses to emotional stimuli involved passive viewing rather than active processing of gains and losses. Emotional engagement of threat stimuli, would presumably initiate a whole-body defensive response, one aspect of which results in changes in autonomic activity. Somatic marker activity, while occurring to guide decision-making at a point where gain/loss contingencies are pre-conscious, and responses are part of a "body-loop" during active processing (Bechara et al., 1996). This may manifest in differential responses tied to shaping the decision-maker's strategy towards long-term gain. Certainly in Study 1 psychopathy as measured by the PCL:SV did not predict impaired somatic marker activity in undergraduates.

Somatic markers are thought to label options as either good or bad, and thus assisting individuals in limiting the perceived value of presented choices. Damasio (1994) suggests that

dysfunction in the somatic marker system may give rise to psychopathic characteristics. One of the central findings with respect to the somatic marker hypothesis is that individuals with VMPFC lesions show reduced autonomic responding in anticipation of disadvantageous decks, failing to acquire anticipatory SCRs. Psychopaths also exhibit reduced autonomic response in anticipation of threat (Hare, 1978; Hare, Frazelle, & Cox, 1978; Ogloff & Wong, 1990). This study yielded no similar findings.

Heart rate findings were also contrary to expectation. Psychopathic offenders did not display increased HR responses to high levels of loss, relative to controls. In this study, HR was lower in psychopathic offenders than non-psychopathic offenders when selecting from decks and appraising outcomes and HR was higher in response to loss in low frequency advantageous decks.

A limitation of the offender sample in this study was that the institutions from which this sample was drawn were predominantly treatment focused. There were psychopaths found in these locations, but given the expressed motivation for change and need to maintain control, (at least in one of the institutions), as a group they were relatively high-functioning, less aggressive, and scored lower on the PCL-R when compared with many other offender samples reported in published literature.

In this study that anxiety level of offenders was quite high. A mean of approximately 18 on the WAS is extreme, as most studies report a range of between 12 and 15 in offender samples. Indeed, in many studies 18 is the mean of the high anxiety group (e.g., Hale et al., 2005; Zeier et al., 2009). It is outside of the scope of this study to discuss the reasons why offenders, particularly those in remand may exhibit high levels of anxiety. The high WAS mean in the offender sample may, however, explain the lack of findings with respect to anxiety and the

interaction between anxiety and psychopathy. As such the findings in this study using the WAS should be interpreted cautiously.

Power was also a major concern in this study. There were a number of contrasts, and a modest number of offenders meeting the recommended cutoff of 30 on the PCL-R (only $n = 7$ in this sample would meet that criteria). A larger sample would allow for more confidence in the results and possibly more significant findings.

Future studies would also benefit from the addition of a standard IGT condition in tandem with the MIGT condition. This would allow for examining more rigorously the extent to which the MIGT indexes differential responses to standard IGT in psychopathic participants. Alternatively, the addition of standard measures of DLPFC as well as VMPFC function, such as the WCST would provide additional support to understanding which aspect of frontal lobe function contributed to observed performance deficits on the IGT in psychopathic offenders. For example, Lösel and Schmucker (2004) included Brickenkamps d2 test (Brickenkamp & Zillmer, 1998). This would allow for better inferences regarding attention and set-shifting which may rely more heavily on the DLPFC relative to the VMPFC.

Despite few significant findings, the observed significant trends in response to card selection outcomes, and that group differences were found in respect of the extent of autonomic response, rather than deficient responding in the psychopathic group, provides evidence suggesting intact somatic markers in psychopathic groups.

By providing an initial account of the differences in performance on a complex decision-making task, and the associated autonomic responses in an undergraduate sample, this study specifically adds to a slowly growing body of scientific knowledge regarding "successful" or community psychopaths. Psychopathy did not predict reversal learning deficits in the student

sample in this study, nor did it predict impaired somatic markers. These two findings raise the possibility that perhaps a) deficits in the VMPFC occur as a function of the lifestyle characteristics of incarcerated psychopaths, or b) intact decision-making in ambiguous situations is predictive of psychopaths not coming into contact with the criminal justice system. However, this must be tempered with the finding that male and female undergraduate students differed in performance on the MIGT. If sex is a major contributor to decision-making under ambiguity, then it becomes important to balance the current findings with an application of this (or a similar) task in a sample of incarcerated female offenders with psychopathy.

To conclude, with the addition of autonomic measures to measuring MIGT performance, modifying the IGT to require reversal learning, conducting the research in undergraduate students and incarcerated offenders, and examining the application of the four-facet model of psychopathy to the psychophysiological findings, this study provides a meaningful, and unique, addition to the scientific literature surrounding the cognitive/emotional deficits underlying psychopathy.

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Appendices

Appendix A - Welsh Anxiety Scale Items (True/False)

Each of the following items takes a True/False form.

1. I find it hard to keep my mind on a task or job.
2. I have more trouble concentrating than others seem to have.
3. At periods my mind seems to work more slowly than usual.
4. When in a group of people I have trouble thinking of the right things to talk about.
5. I have often lost out on things because I couldn't make my mind up soon enough.
6. I usually have to stop and think before I act even in trifling matters.
7. I have several times had a change of heart about my life work.
8. Sometimes some important thought will run through my mind and bother me for days.
9. I am apt to take disappointments so keenly that I can't keep them out of my mind.
10. I do many things which I regret afterwards (I regret things more and more often than others seem to).
11. I feel anxiety about something or someone almost all the time.
12. I must admit that I have at times been worried beyond reason over something that really did not matter.
13. I wish I could get over worrying about things I have said that may have injured other people's feelings.
14. I worry quite a bit over possible misfortunes.
15. I brood a great deal.
16. I have often felt guilty because I have pretended to feel more sorry about something than I really was.

17. Even when I am with people I feel lonely much of the time.

18. I wish I could be as happy as others seem to be.

19. Most of the time I feel blue.

20. I very seldom have spells of the blues.

21. Life is a strain for me much of the time.

22. I feel tired a good deal of the time.

23. I have had periods of days, weeks, or months where I couldn't take care of things because I couldn't get going.

24. I have difficulty in starting to do things.

25. My plans have frequently seemed so full of difficulties that I have had to give them up.

26. I have sometimes felt that difficulties were piling up so high that I could not overcome them.

27. Often, even though everything is going fine for me, I feel that I don't care about anything.

28. I have often felt that strangers were looking at me critically.

29. I am apt to pass up something I want to do because others feel that I am not going about it the right way.

30. It makes me feel like a failure when I hear of success of someone I know well.

31. Often I cross the street in order not to meet someone I see.

32. People often disappoint me.

33. I feel unable to tell anyone all about myself.

34. I am easily embarrassed.

35. Criticism or scolding hurts me terribly.

36. At time I think that I am no good at all.

37. I sometimes feel that I am about to go to pieces.

38. I often feel as if things were not real.

39. I have a daydream life about which I do not tell other people.

Appendix B - Michigan Alcohol Screening Test

1. Do you feel you are a normal drinker? ("normal" - drink as much or less than most other people)?

* Yes
* No

2. Have you ever awakened the morning after some drinking the night before and found that you could not remember a part of the evening?

* Yes
* No

3. Does any near relative or close friend ever worry or complain about your drinking?

* Yes
* No

4. Can you stop drinking without difficulty after one or two drinks?

* Yes
* No

5. Do you ever feel guilty about your drinking?

* Yes
* No

6. Have you ever attended a meeting of Alcoholics Anonymous (AA)?

* Yes
* No

7. Have you ever gotten into physical fights when drinking?

* Yes
* No

8. Has drinking ever created problems between you and a near relative or close friend?

* Yes
* No

9. Has any family member or close friend gone to anyone for help about your drinking?

* Yes
* No

10. Have you ever lost friends because of your drinking?

* Yes
* No

11. Have you ever gotten into trouble at work because of drinking?

* Yes
* No

12. Have you ever lost a job because of drinking?

* Yes
* No

13. Have you ever neglected your obligations, your family, or your work for two or more days in a row because you were drinking?

* Yes
* No

14. Do you drink before noon fairly often?

* Yes
* No

15. Have you ever been told you have liver trouble such as cirrhosis?

* Yes
* No

16. After heavy drinking have you ever had delirium tremens (D.T.'s), severe shaking, visual or auditory (hearing) hallucinations?

* Yes
* No

17. Have you ever gone to anyone for help about your drinking?

* Yes
* No

18. Have you ever been hospitalized because of drinking?

* Yes
* No

19. Has your drinking ever resulted in your being hospitalized in a psychiatric ward?

* Yes
* No

20. Have you ever gone to any doctor, social worker, clergyman or mental health clinic for help with any emotional problem in which drinking was part of the problem?

* Yes
* No

21. Have you been arrested more than once for driving under the influence of alcohol?

* Yes
* No

22. Have you ever been arrested, even for a few hours, because of other behavior while drinking?

* Yes
* No

Appendix C - Drug Abuse Screening Test

Please check the one response to each item that best describes how you have felt over the past 12 months.

1. Have you used drugs other than those required for medical reasons?

   * Yes
   * No

2. Have you abused prescription drugs?

   * Yes
   * No

3. Do you abuse more than one drug at a time?

   * Yes
   * No

4. Can you get through the week without using drugs?

   * Yes
   * No

5. Are you always able to stop using drugs when you want to?

   * Yes
   * No

6. Have you had "blackouts" or "flashbacks" as a result of drug use?

   * Yes
   * No

7. Do you ever feel bad or guilty about your drug use?

   * Yes
   * No

8. Does your spouse (or parents) ever complain about your involvement with drugs?

   * Yes
   * No

9. Has drug abuse created problems between you and your spouse or your parents?

* Yes
* No

10. Have you lost friends because of your use of drugs?

* Yes
* No

11. Have you neglected your family because of your use of drugs?

* Yes
* No

12. Have you been in trouble at work because of your use of drugs?

* Yes
* No

13. Have you lost a job because of drug abuse?

* Yes
* No

14. Have you gotten into fights when under the influence of drugs?

* Yes
* No

15. Have you engaged in illegal activities in order to obtain drugs?

* Yes
* No

16. Have you been arrested for possession of illegal drugs?

* Yes
* No

17. Have you ever experienced withdrawal symptoms (felt sick) when you stopped taking drugs?

* Yes
* No

18. Have you had medical problems as a result of your drug use (e.g., memory loss, hepatitis, convulsions, bleeding, etc.)?

* Yes
* No

19. Have you gone to anyone for help for a drug problem?

* Yes
* No

20. Have you been involved in a treatment program especially related to drug use?

* Yes
* No