Measuring the Extended Phenotype Using a Dimensional Model of Personality in Bipolar and Gambling Disorder

by

Nayani Ramakrishnan

A thesis submitted in conformity with the requirements for the degree of Masters of Arts

Graduate Department of Psychology
University of Toronto

© Copyright by Nayani Ramakrishnan 2019
Abstract

The Personality Inventory for DSM-5 (PID-5) was used to determine whether pathological personality domains can discriminate between gambling disorder (GD) participants and community controls, and also bipolar disorder (BD) participants and community controls, and if so, which of the PID-5 domains best distinguish between the groups. Understanding personality traits associated with impulsivity may assist with diagnostic accuracy and contribute to the understanding of the etiology of the disorders. GD participants, BD participants and community controls completed the PID-5 questionnaire on an online platform. The findings revealed significant group differences on all PID-5 domains, except Antagonism. At the domain level, Disinhibition best discriminated between the diagnostic and control groups for both GD and BD. The facets Impulsivity and Distractibility contributed the most to the discrimination between groups, for GD and BD participants respectively. The results emphasize the potential clinical utility of the PID-5 in distinguishing between normative and maladaptive impulsive behaviours.
Acknowledgements

Thank you to Diandra Leslie, the Goghari and Hodgins lab for their assistance with study implementation. A special thank you to Matthew McPhee for his assistance with statistical analyses. I would also like to express my gratitude to Dr. Suzanne Erb, and Dr. Vina Goghari for their endless support, and guidance throughout this process.

The current study was funded by the *Gambling Family Study of Clinical and Cognitive Functioning* (Alberta Gambling Research Institute Grant 68) and *Cell Membrane Alterations in Bipolar Disorder: A Neuroimaging, Peripheral Lipid, and Cognitive Biomarkers* Study (Hotchkiss Brain Institute/Pfizer Award). Dr. Goghari was funded by a Canadian Institutes of Health Research New Investigator Salary Award.
# TABLE OF CONTENTS

LIST OF TABLES .............................................................................................................. V

LIST OF FIGURES .......................................................................................................... VI

1. **INTRODUCTION** .................................................................................................. 1
   1.1. **BIPOLAR DISORDER** .................................................................................... 1
   1.2. **GAMBLING DISORDER** ................................................................................ 3
   1.3. **IMPULSIVITY** ............................................................................................ 5
   1.4. **PERSONALITY TRAITS AND PSYCHOPATHOLOGY** .................................. 8
   1.5. **PID-5** ......................................................................................................... 11

2. **THE PRESENT STUDY** .................................................................................... 12
   2.1. **HYPOTHESES** ............................................................................................ 13
       2.1.1. *Gambling Participants vs. Community Controls* ...................................... 13
       2.1.2. *Bipolar Participants vs. Community Controls* ......................................... 14

3. **METHODS** ...................................................................................................... 15
   3.1. **PARTICIPANT RECRUITMENT** .................................................................. 15
   3.2. **PROCEDURE** ............................................................................................ 16
   3.3. **MEASURES** ................................................................................................ 18
       3.3.1. *Composite International Diagnostic Interview (CIDI)* .............................. 18
       3.3.2. *Structured Clinical Interview for DSM-5 Disorders (SCID-5)* ........... 19
       3.3.3. *Young Mania Rating Scale (YMRS)* ....................................................... 20
       3.3.4. *Hamilton Depression Rating Scale (HAMD)* ............................................ 20
       3.3.5. *Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001)* .......... 21
       3.3.6. *PID-5* .................................................................................................... 21
   3.4. **STATISTICAL ANALYSES** ......................................................................... 22

4. **RESULTS** .......................................................................................................... 23
   4.1. **DEMOGRAPHICS AND DESCRIPTIVE DATA FOR STUDY 1** ...................... 23
   4.2. **DEMOGRAPHICS AND DESCRIPTIVE DATA FOR STUDY 2** ...................... 24
   4.3. **STUDY 1: MANCOVA RESULTS** ............................................................. 25
   4.4. **STUDY 2: MANCOVA RESULTS** ............................................................. 26
   4.5. **DISCRIMINANT FUNCTION ANALYSES ON PID-5 DOMAINS** ................ 27
   4.6. **FUNCTION DISCRIMINANT ANALYSES ON PID-5 FACETS** ................. 28
   4.7. **STEP-WISE DISCRIMINANT ANALYSES ON ALL PID-5 FACETS** .......... 29
   4.8. **BIVARIATE CORRELATIONS OF MOOD SYMPTOMATOLOGY AND PERSONALITY TRAITS** .......................................................... 29

5. **DISCUSSION** .................................................................................................... 31
   5.1. **LIMITATIONS** ............................................................................................ 42
   6. **CONCLUSION** .................................................................................................. 44

7. **REFERENCES** ................................................................................................... 46

8. **APPENDIX** ........................................................................................................ 56
LIST OF TABLES

Table 1. Five-Factor Model of Personality-FFM Description (Parks-Leduc, Feldman, & Bardi, 2015).

Table 2. Five-Factor Model of Personality-FFM Traits

Table 3. Descriptions of Personality Traits for the Personality Inventory for DSM-5 (PID-5; Krueger, & Markon, 2014).

Table 4. Personality Inventory for DSM-5 (PID-5) Traits and Domains

Table 5. Representation of the UPPS-P model of impulsivity in DSM-5 disorder diagnostic criteria (Modified from Um, Hershberger, Whitt, & Cyders, 2018)

Table 6. PID-5 personality facets primarily contributing to PID-5 domain scores

Table 7. Tests of Between-Subject Effects for Studies 1 and 2 on PID-5 Domains

Table 8. Group Comparisons for the PID-5 Personality Domains

Table 9. PID-5 Domain with Discriminant Function (Structure Matrix) and Standardized Discriminant Function Coefficients.

Table 10. Correlations of PID-5 facets with discriminant function (structure matrix) and standardized discriminant function coefficients

Table 11. Study 1: Stepwise Discriminant Function Analyses on all Facets of PID-5 Domains

Table 12. Study 2: Stepwise Discriminant Function Analyses on all Facets of PID-5 Domains

Table 13. Study 1 (GD Participants): Bivariate correlations (Pearson r) for Personality Traits, Depressive and Mania Symptoms and Gambling Severity

Table 14. Study 1 (Control Participants): Bivariate correlations (Pearson r) for Personality Traits, Depressive, and Mania Symptoms and Gambling Severity

Table 15. Study 2 (BD Participants): Bivariate correlations (Pearson r) for Personality Traits, Depressive, and Mania Symptoms and Gambling Severity

Table 16. Study 2 (Control Participants): Bivariate correlations (Pearson r) for Personality Traits, Depressive, and Mania Symptoms and Gambling Severity

Table 17. Demographics: Study 1 (GD Participants)

Table 18. Demographics: Study 1 (Control Participants)

Table 19. Demographics: Study 2 (BD Participants)

Table 20. Demographics: Study 2 (Control Participants)
LIST OF FIGURES

Figure 1. Graph shows mean-level differences across diagnostic and control groups for each PID-5 domain.

Figure 2. Graph shows mean-level differences across diagnostic and control groups for each PID-5 domain (data has been log transformed).
1. Introduction

The classification of mental disorders occurs through detailed observation of behaviour. While the DSM is evolving from a categorical schema, to one that considers conditions dimensionally, underlying personality traits are often overlooked across conditions. The investigation of personality traits is crucial because it can bridge comorbid conditions. For instance, bipolar disorder (a mood disorder) and gambling disorder (an addictive disorder) are characterized by elevated levels of impulsivity. If one does not consider specific facets contributing to impulsive behaviour in the diagnosis of these conditions, it is difficult to find the differential mechanisms between the two. However, with the use of a dimensional model of personality, one can elucidate the personality traits of these disorders which can be used to assist with diagnostic accuracy and potentially develop transdiagnostic treatments.

1.1. Bipolar Disorder

It is common for stressful life events to lead to fluctuations in mood, cognition, and behaviour. However, when these changes become persistent there may be an underlying affective disorder (Grande, Berk, Birmaher, & Vieta, 2016). Affective disorders are classified by manic, hypomanic, and/or depressive episodes and include bipolar I disorder (BD-I), bipolar II disorder (BD-II), cyclothymic disorder, and anxiety disorders as well (Phillips & Kupfer, 2013; Fava, 1996; Mennin, Heimberg, Fresco, & Ritter, 2008). Bipolar disorder (BD) is a chronic mood disorder that has a lifetime prevalence of up to approximately 15% (Dell'Aglio Jr, Basso, Argimon, & Arteche, 2013). Due to its chronicity, individuals diagnosed with BD-I and II are responsible for the loss of more “disability-adjusted life years” than all forms of common neurologic conditions combined (Alonso et al., 2011; Merikangas et al., 2011).
The DSM-5 places BD and related disorders between schizophrenia and depressive disorders, as BD is known to bridge the two with respect to its symptomatology (American Psychiatric Association, 2013). BD-I is classified by manic or hypomanic, and depressive episodes. Manic or hypomanic episodes are a distinct period of mood elevated states and persistent energy which vary in length and severity (Grande et al., 2016). In order to receive a diagnosis of BD-I, the individual must have experienced a manic episode, characterized by, for example, elevated or irritable mood, grandiosity, decreased need for sleep, distractibility, and an excessive involvement in high risk activities. Of note, while the occurrence of major depressive episodes is common with individuals diagnosed with BD-I, such episodes are not required for a diagnosis (American Psychiatric Association, 2013).

BD-II differs from BD-I in that it requires at least one hypomanic and one major depressive episode. A major depressive episode is characterized by, for example, depressed mood, diminished interest or pleasure in almost all activities, significant weight loss (not as a result of dieting) or weight gain, insomnia, psychomotor agitation, and the diminished ability to think or concentrate. Similar to BD-I, the symptoms should cause significant distress or impairment and should not be attributed to substance-use or another medical condition (American Psychiatric Association, 2013). Another distinguishing feature of BD-II is that the individual must have never experienced a manic episode.

Almost all BD patients have a comorbid psychiatric disorder, usually disruptive, impulse-control and conduct disorders. Of note, it has been found that mood disorders are also highly comorbid with problem gambling, with 8.8% of problem gamblers reporting BD, and approximately 1 in 10 patients diagnosed with BD being at moderate to severe risk for developing problem gambling (Jones et al., 2015; Lister, Milosevic & Ledgerwood, 2015). In
addition, the onset and persistence of problem gambling are predicted by various DSM-IV disorders including, anxiety, mood, impulse-control and substance-use disorders (Kessler et al., 2008; Dowling, Merkouris, & Lorains, 2016). Nevertheless, there is a gap in the literature exploring the extent to which mood disorders influence the “clinical presentation” of problem gamblers (Dowling, Merkouris, & Lorains, 2016).

1.2. Gambling Disorder

For most individuals, gambling is considered to be a harmless leisure activity; however, when it becomes excessive and impairs one’s daily functioning, then symptoms of an underlying pathology become evident (Ladouceur & Walker, 2001). Problem and pathological gambling, also referred to as gambling disorder (GD), occurs in approximately 0.7%-6.5% of people across the world (Calado & Griffiths, 2016). It is characterized by cognitive dysfunctions, including increased impulsivity and the inability to control the impulse to gamble despite adverse consequences (Singer, Anselme, Robinson, & Vezina, 2014). Moreover, GD is the only non-substance related disorder to be included in the substance-related and addictive disorder domain of the DSM-5. For a diagnosis of GD, the individual must have persistent gambling behaviour characterized by the need to gamble with, for example, increased amounts of money over time, restlessness, irritability, constantly preoccupied with thoughts of gambling, gambling when feeling distressed, lying, and jeopardizing work and relationships, these symptoms should lead to clinically significant impairment or distress (American Psychiatric Association, 2013). In addition, the gambling behaviour should not be a result of a manic episode. During a manic episode, there is loss of judgment which may contribute to the development of excessive gambling, and an individual with GD may reveal behaviour that resembles a manic episode. In
order to differentiate between the two, symptoms of manic episode should disappear when the individual is not gambling and vice versa (American Psychiatric Association, 2013).

Individuals with GD have comorbidities with mental disorders including substance-use, anxiety, and personality disorders as well as depression. In the DSM-IV, GD was considered to be an impulse-control disorder characterized by “persistent and recurrent maladaptive behaviour…that disrupts personal, family, or vocational pursuits” (Kessler et al., 2008; American Psychiatric Association, 2000). In the DSM-5, GD was moved to substance-related and addictive disorders because evidence showed that it activated reward systems similar to those activated by drug abuse. However, this change has stirred controversy with experts, some of whom argue that it should be moved back to impulse-control disorders. For instance, it has been found that GD subjects share brain abnormalities and genetic vulnerabilities with individuals with mania (demonstrated through similar patterns of prefrontal cortical dysfunction), substance-use disorder and major depressive disorder (Singer et al., 2014; Mann et al., 2016). It has also been argued that the change in categorization of GD in the DSM-5 does not have a clear clinical utility. For example, individuals diagnosed with an addiction can be significantly influenced by preventive treatment measures; however, this is not the case for individuals diagnosed with an “impulse control disorder” (Grant et al., 2014; Mann et al., 2016). In addition, the International Classification of Diseases (ICD-11) cross lists gambling (and gaming) disorder under: “disorders due to substance use or addictive behaviours” and “impulse control disorders”. Therefore, categorizing GD as an addiction, as opposed to an impulse control disorder, is regarded as controversial and due to the individual variation of GD (e.g. varying levels of impulsivity, decision making) it is an area of literature that requires more investigation (Singer et al., 2014).
In support of classifying GD as a “behavioural addiction” to be included with the substance-use disorders (as is the case in the current DSM-5), evidence supports the idea that individuals with GD have altered reward circuitry and their “abnormal” activation of reward promotes the development of addictive behavior. Moreover, it was found that personality traits of GD have more in common with addictive disorders (Slutske, Caspi, Moffitt, & Poulton, 2005). An extensive review regarding pathological gambling found that GD’s etiology, tolerance, comorbidities, neurobiological mechanisms and response to treatment resemble substance-related addictions (for complete review see Grant, Potenza, Weinstein, & Gorelick, 2010). In particular, recent evidence has found that this re-categorization of GD to substance-use and related disorders has successfully helped in identifying and diagnosing a larger range of individuals with symptoms of pathological gambling compared to the DSM-IV (Rennert et al., 2014; Rash & Petry, 2016). However, this could also be a result of the reduced number of criteria (in the DSM-5) required to diagnose an individual with GD. Therefore, studies recommend the use of additional psychometric tests (e.g. tests assessing personality traits such as impulsivity) for a thorough evaluation of GD (Petry et al., 2014; Rennert et al., 2015). A measure of impulsivity can aid in the diagnosis of GD because increased levels of impulsivity is a common trait found in pathological gamblers, and it is also significantly correlated with the severity of gambling (Steel & Blaszczynski, 1998; Hodgins & Holub, 2015). Thus, measures of impulsivity play a critical role in corroborating a diagnosis of GD (Forbush et al., 2008).

1.3. Impulsivity

Impulsivity is a multifaceted construct associated with individuals who react to stimuli without thinking, and consideration for future consequences (Moeller et al., 2001; Swann, 2009). Impulsive traits characterize many psychiatric conditions including attention deficit/hyperactivity
disorder (ADHD), substance-use, bipolar, gambling and schizophrenia (Bari & Robbins, 2013; Sharma et al., 2014; Hodgins & Holub, 2015). More recently, impulsivity has been used as a prominent transdiagnostic trait to characterize specific psychiatric conditions. For example, a common feature associated with both BD-II and the development of early-life gambling disorder is impulsivity, which can contribute to suicide ideations and substance-use disorders (American Psychiatric Association, 2013).

Impulsivity is a complex multi-dimensional personality trait, that can be assessed through self-report questionnaires such as the Barratt Impulsivity Scale (BIS-11; Patton et al., 1995), the UPPS-P (UPPS-P; Cyders et al., 2014), and/or by behaviour through a lab task paradigm (Bari & Robbins, 2013). The BIS-11 measures three broad components of impulsivity (known as second order factors): attentional, motor and non-planning. Each of these components assesses more specific facets (known as first order factors). More specifically, the attentional factor assesses attention and cognitive instability, the motor factor assesses motor and perseverance, and the non-planning factor assesses self-control and cognitive complexity (Patton et al., 1995). By comparison, the UPPS-P (derived from the Five-Factor Model of Personality) assesses personality facets that are associated with impulsivity, with the traits clearly represented in DSM-5 diagnostic criteria (see Table 5; Um, Hershberger, Whitt, & Cyders, 2018). It contains five subscales: negative urgency (tendency to experience strong impulses in response to negative mood), positive urgency (tendency to experience strong impulses in response to positive mood), (lack of) premeditation, (lack of) perseverance and sensation seeking (assessing both the tendency to pursue exciting activities and an openness to new experiences; Cyders et al., 2014). Although these facets of impulsivity, as described in the UPPS-P, are related in various ways and reveal overlapping mechanisms, prior
research shows that some of these underlying neural mechanisms could be working independently of one another (Dalley & Robbins, 2017).

Impulsive traits are manifested through mechanisms and consequences of affective disorders (see Table 4). As such, it is a common trait and plays a significant role during manic, and depressed episodes of individuals with BD (Henna et al., 2013; Ozten et al., 2015; Strakowski et al., 2010). Indeed, recent research shows that higher attentional impulsivity (on the BIS-11) may contribute to the development of affective disorders (Strakowski et al., 2010; Henna et al., 2013). As well, BD patients generally experience elevated impulsive traits, and manic episodes are typically associated with motor impulsivity (Ozten et al., 2015). By contrast, depressive episodes are associated with non-planning impulsivity (Ozten et al., 2015). In GD patients, evidence shows that as an individual ages, positive urgency increases, sensation seeking stabilizes, and lack of premeditation decreases (Savvidou et al., 2016). Generally, negative urgency and sensation seeking (on the UPPS-P) show predictive capacity of GD (Savvidou et al., 2016). Furthermore, urgency is generally positively correlated with psychopathology in accordance with DSM-IV criteria, and negatively associated with the personality traits of self-directedness and cooperativeness (Savvidou et al., 2016). While individuals with an addictive disorder have elevated levels of impulsivity, it has also been found that impulsivity in GD is represented by independent factors, including trait impulsivity, sensation seeking and behavioural impulsivity based on performance based tasks; however, the latter two factors are found to be involved with gambling itself, and not with pathology (Grant et al., 2010; Hodgins & Holub, 2015). Prior work has established that impulsivity plays a significant role in both mood disorders as well as GD. However, it is not until very recently that a study conducted by Shakeel, Hodgins, & Goghari, (2018), compared the role that impulsivity plays in both BD and GD
patients. As expected, it was found that compared to the controls, BD and GD patients had significantly higher levels of impulsivity. In particular, urgency showed the strongest association between GD and BD with BD patients showing higher levels of positive urgency (Shakeel et al., 2018).

1.4. Personality Traits and Psychopathology

As impulsivity is a multifaceted construct that is foundational to many personality models, it is important to examine the relationship between specific personality facets contributing to impulsive behaviour and psychopathology, because it can provide a more comprehensive understanding of a diagnosis. One of the first studies investigating the prevalence of behavioural addictions in patients with mood disorders found that there was a significant correlation between the two disorders, notably, this was largely attributed to higher levels of impulsivity (Di Nicola et al., 2010). As per the discussion above, it is well-established that impulsivity is a personality trait that is elevated in both BD and GD, then how can one discriminate amongst both diagnostic groups utilizing personality traits?

Personality can be best described as the integration of an individual’s subjective behaviour patterns including, “conscious, concrete and habitual behaviours, experiences of self and of the surrounding world, conscious, explicit psychic thinking, habitual desires and fears as well as unconscious behavioural patterns” (Kernberg, 2016; Fajkowska, 2018). One of the most researched personality taxonomies is the Five-Factor Model (FFM), where a large number of “normative” personality traits are categorized into five broad constructs: Openness to Experience, Agreeableness, Extraversion, Conscientiousness, and Emotional Stability, this is commonly known as the “Big-5” (see Tables 1 and 2; McCrae & Costa, 2008; Parks-Leduc, Feldman, & Bardi, 2015; Pytlik Zillig, Hemenover, & Dienstbier, 2002). Recently, with the
publication of the DSM-5, a model of personality disorders based on personality dysfunction was developed. The Personality Inventory for DSM-5 (PID-5; (Krueger et al., 2012) was designed to assess maladaptive personality traits which also map onto five broad domains: Negative Affect, Detachment, Antagonism, Disinhibition, and Psychoticism (see Tables 3 and 4).

Psychopathology is the study of environmental, behavioural, and genetic factors that contribute to the development and classification of mental disorders. Personality plays an integral role in psychopathology, as it influences the presentation, appearance, or expression of symptomology (Widiger, 2011). In one of the first studies to examine personality traits and psychopathology using the FFM, Trull and Sher (1994) found that using personality traits, specifically the Big-5, aided with developing psychopathological distinctions in Axis I disorders. The results showed that scores on the NEO (NEO-FFI, which is a self-report questionnaire assessing the FFM; Costa, & McCrae, 1992) specified differential diagnoses and supported the idea of the clinical utility of a personality assessment to complement diagnoses (Trull and Sher, 1994). For instance, it was found that low conscientiousness was associated with impulsivity, anxiety, and depression (Trull & Sher, 1994). Utilizing these personality traits can improve diagnostic accuracy, for example, these findings helped distinguish between individuals with substance use disorders with and without depression (Um et al., 2018). More importantly, BD-I and II, especially in their early stages, are difficult to diagnose accurately in clinical settings due to the complexity of the presentation of symptoms (Phillips & Kupfer, 2013). Likewise, there is a high rate of comorbid affective disorders in GD (Jiménez-Murcia et al., 2009). This illustrates the strong need to closely examine mental disorders by assessing personality traits. Recent evidence shows that BD-I and II patients have higher levels of neuroticism, aggressiveness and disinhibition relative to healthy controls (Sparding et al., 2017). Similarly, a study conducted by
Heath et al., (2018) found that BD and Depressive disorder subjects scored significantly higher on the Detachment domain compared to the psychotic and alcohol-use disorder (AUD) groups. Building on these past findings, BD is associated with elevated levels of extraversion compared to unipolar depression and other internalizing disorders (Quilty, Pelletier, DeYoung, & Bagby, 2013b; Sariusz-Skapska et al., 2003; Vinberg Christensen & Vedel Kessing, 2006; Tackett et al., 2008). While very few studies have looked at maladaptive personality traits in GD—the literature has primarily focused on the relationship between personality disorders and GD—studies examining the FFM and GD show elevated of neuroticism and psychoticism compared to non-problem gamblers (Bagby et al., 2007; Myrseth et al., 2009). GD subjects also scored lower on the Conscientiousness and Openness domain compared to non-problem gamblers (Bagby et al., 2007; Myrseth et al., 2009).

A study conducted by Del Pino-Gutiérrez et al., (2017) investigated relevant personality traits in impulsivity related disorders. They found that GD with substance-use disorder (SUD) had the highest scores in novelty seeking compared to the SUD only group. In turn, these results demonstrate that GD patients with SUD exhibit higher levels of sensation seeking, impulsivity, risk-taking, and carelessness (Del Pino-Gutiérrez et al., 2017).

Over the years, the literature has focused on using personality traits to contribute to the assessment of differential diagnoses (Heath et al., 2018). It has been found that high levels of neuroticism (described in Tables 1 and 2) has been linked to the development of mood disorders, anxiety disorders, somatoform disorders, schizophrenia, and eating disorders (Lahey, 2009). Nevertheless, examining personality models to inform psychopathology does not come without its limitations (Krueger & Markon, 2014), and Trull and Sher (1994) note that a general measure of personality cannot assess specific psychological symptoms. However, if used in conjunction
with other personality assessments, it can broaden the understanding of the clinical presentation of specific conditions. Despite existing evidence on shared personality traits in different impulsivity spectrum disorders such as mood and substance use disorders, no study to date has examined maladaptive personality traits in a mood and addictive disorder (Del Pino-Gutiérrez et al., 2017).

1.5. PID-5

The PID-5 is a 220-item self-report personality trait model that assesses five broad domains of personality with respect to 25 specific maladaptive traits that align with FFM: Negative Affectivity (vs. Emotional Stability), Detachment (vs. Extraversion), Antagonism (vs. Agreeableness), Disinhibition (vs. Conscientiousness), and Psychoticism (vs. Openness) (see Tables 3 and 4; American Psychiatric Association, 2013). The construction of a hybrid, dimensional model of personality was initiated because there was no tool to assess maladaptive personality traits without consulting or forming a diagnosis of personality disorder (Krueger et al., 2012). Firstly, the construction of the PID-5 focused on identifying maladaptive personality traits, and to extend the FFM, this was completed using traits of personality disorder as the foundation (Krueger et al., 2012; Fowler et al., 2017). Initially 37 specific personality facets were identified and a total of 762 participants completed the first round of testing, only after 3 rounds were the 25 personality facets established (Krueger et al., 2012).

As previously mentioned, it is critical to use a diverse range of personality assessments to gain an in-depth understanding of the traits involved in symptomology. The PID-5 model adheres to this by focusing on multiple broad, yet, relevant areas of personality variation in patients (American Psychiatric Association, 2013). This classification system inherently allows one to develop a thorough understanding of the characteristics of personality traits observed in an
individual and his/her pathological profile. This provides the clinician with more information and subsequently, an improved course of treatment for the patient. For instance, in a study conducted by Fowler et al., (2017) it was found that the PID-5, specifically the trait domains, Negative Affect, Detachment, and Psychoticism showed incremental validity in predicting baseline symptoms compared to demographics, comorbidities, and even the FFM personality traits. Therefore, an assessment of personality functioning and pathological personality traits can be considered even necessary for an accurate diagnosis (American Psychiatric Association, 2013; Forbush et al., 2008; Fowler et al., 2017).

2. The Present Study

The purpose of present study was to investigate whether PID-5 domains can discriminate between GD participants and community controls, as well as BD participants and community controls. A secondary aim of this study was to examine which of the PID-5 domains best distinguish between both groups and community controls. Lastly, the third objective of this study was to examine which of the PID-5 facet scales best discriminate within each of the significant domains that discriminate between the diagnostic and control groups. Research on shared and differential personality traits and facets associated with BD and GD could inform similar characteristics and dysfunctional behaviours across conditions characterized by the multifaceted construct of impulsivity, this could potentially be useful in developing transdiagnostic treatments (Del Pino-Gutiérrez et al., 2017). Until recently, the literature has primarily focused on the relationship between “normative” personality traits and specific psychiatric conditions. To our knowledge, this is the first study to utilize pathological personality dimensions to evaluate an addictive and mood disorder characterized by impulsivity.
2.1. Hypotheses

2.1.1. Gambling Participants vs. Community Controls

Based on prior findings, it is hypothesized\(^1\) that:

1) At least four of the five PID-5 domains (Negative Affect, Detachment, Disinhibition, and Psychoticism) will discriminate between GD participants and community controls. This is based on the findings from Bach, Sellbom, & Simonsen, (2018) showing no significant differences for the Antagonism domain for clinical (outpatients from a psychiatric hospital with a non-psychotic mental disorder) and community controls (see also Heath et al., 2018; Pires et al., 2019).

2) Disinhibition and Negative Affect will contribute the most to the discrimination between GD participants and community controls. This is based on findings from Nigro, Ciccarelli, & Cosenza, (2018) showing that the decision to continue to gamble (chasing) was strongly associated with the Disinhibition domain. In addition, research shows that pathological gamblers scored significantly higher on the Neuroticism domain compared to non-pathological gamblers (Bagby et al., 2007; Myrseth et al., 2009), and because the Neuroticism domain is akin to that of the Negative Affect domain of the PID-5, it is believed that Negative Affect will also strongly discriminate between the two groups.

3) The Impulsivity facet of the Disinhibition domain, and the Emotional Lability facet of the Negative Affect domain will contribute the most to this discrimination (based on

---

\(^1\) Hypotheses were made based on past findings, in addition to examining the relationship between DSM-5 criteria and specifiers for GD as well as the personality facets contributing to the PID-5 domains (see Tables 3 and 4).
the symptomology of GD discussed in the Introduction). These facets are also expected to be retained in the stepwise discriminant function analysis.

2.1.2. Bipolar Participants vs. Community Controls

Based on prior findings, it is hypothesized\(^2\) that:

1) At least four of the five PID-5 domains (Negative Affect, Detachment, Disinhibition, and Psychoticism) will discriminate between BD participants (who are currently taking medication for their symptoms) and community controls. This is based on the findings from Heath et al., (2018) and Bastiaens et al., (2019) showing no significant differences for the Antagonism domain between individuals diagnosed with psychotic disorders and other psychiatric conditions (including Depressive, Bipolar, and Alcohol Use Disorders).

2) Detachment and Psychoticism will contribute the most to the discrimination between BD participants and community controls. This is based on the findings from Heath et al., (2018) which showed that BD individuals scored the highest on the Detachment domain compared to other psychiatric conditions. In addition, findings from Bagby et al., (1996) and Quilty et al., (2013b) demonstrated that BD patients scored significantly higher than recovered unipolar depressed patients on the Openness domain which is akin to that of the Psychoticism domain of the PID-5. Thus, it is believed that Psychoticism will also strongly discriminate between both groups.

3) The Anhedonia facet of the Detachment domain, and the Eccentricity facet of the Psychoticism domain will contribute the most to this discrimination (based on the

\(^2\) Hypotheses were made based on past findings, in addition to examining the relationship between DSM-5 criteria and specifiers for BD as well as the personality facets contributing to the PID-5 domains (see Tables 3 and 4).
symptomology of BD discussed in the Introduction). These facets are also expected to be retained in the stepwise discriminant function analysis.

3. Methods

The study was approved by the University of Calgary Research Ethics Board. Data were collected as part of two separate protocols and brought together for comparison. All participants completed questionnaires and cognitive tasks over two sessions measuring IQ, executive functioning, social cognition, personality, and stress as a part of a broader program of research. For the purposes of this study, the focus will remain on individuals with BD, GD, and community controls who completed the PID-5 questionnaire, which was administered on Qualtrics (an online platform).

3.1. Participant Recruitment

Study 1:

GD participants \( n = 47 \) and respective controls \( n = 50 \) were recruited from clinics, through local treatment agencies, past studies, and the community (e.g. through Kijiji ads, posters). Potential participants were initially screened through the phone using the Gambling Family Study Health Screen. The health screen was used to exclude any participants with a past or current diagnosis of a psychotic disorder, chronic neurological illness, cardiovascular problems (e.g., stroke or T.I.A.), and/or severe head injuries. In addition, community controls were excluded if they had a family history, (including second degree relatives) of problem gambling. The NORC DSM-IV Screen for Gambling Problems (NODS), modified for the DSM-5 was included as a part of the health screen. This screen specifically asked participants about their gambling experiences. Potential community controls must score a 0, and potential GD participants must score a minimum of 4 on this screen to
be eligible for the study. Inclusion criteria for GD included the presence of lifetime GD, and the absence of BD or psychosis.

**Study 2:**

Similarly, BD participants \( n = 24 \) and respective controls \( n = 23 \) were recruited through media announcements, past studies, as well as the Mood Disorders Clinic at Foothills Medical Center. An initial phone interview (assessing the same criteria as Study 1) was used to screen potential participants. In addition, community controls were excluded if they had a family history, (including second degree relatives) of psychotic and/or bipolar disorder. Inclusion criteria for BD included a lifetime diagnosis of BD, and the absence of GD.

In both studies, participants who were apart of the clinical conditions (GD or BD), and have had a past or current diagnosis of a psychiatric condition (excluding psychotic disorders) were included. The exclusion criteria for both studies included:

- An intelligence quotient (IQ) less than 80 on the Wechsler Test of Adult Reading
- History of stroke
- Community controls with a personal or family history of gambling disorder and/or a personal or family history of psychotic/bipolar disorder
- Study 1: Diagnosis of a past or current psychotic disorder and/or current or past neurological condition (e.g. multiple sclerosis, epilepsy, dementia, delirium) that can significantly impact responses on the self-report questionnaires.
- Study 2: Diagnosis of gambling disorder (past or current) and/or current or past neurological condition (e.g. multiple sclerosis, epilepsy, dementia, delirium) that can significantly impact responses on the self-report questionnaires

3.2. Procedure
Both studies followed a similar data collection process, which is outlined in detail below. Following the health screen (administered during the phone interview), all participants who met the eligibility criteria were provided with a consent form on their first visit, and completed a battery of cognitive measures and self-report questionnaires over two sessions. The first session was designed to collect detailed information regarding demographics, and past medical history through clinical interviews. In addition, self-report questionnaires were administered to assess past brain injury (e.g., Brain Injury Screening Questionnaire [Brain Injury Research Centre Mount Sinai, 2011]), impulsivity (e.g., UPPS-P Impulsive Behaviour Scale; Lynam, Smith, Whiteside, & Cyders, 2006), and substance use (e.g., a Substance-Use Questionnaire (SUQ) developed by Dr. Hodgins’ lab). In both studies, the Composite International Diagnostic Interview (CIDI; Kessler et al., 2008), and the Structured Clinical Interview for DSM-5 Disorders (SCID-5), were administered to confirm a diagnosis of BD and GD (Haro et al., 2006). An additional component to Study 1, assessed the history, frequency, and severity of gambling, and identified a lifetime DSM-5 GD diagnosis for GD participants, using information from a modified CIDI alongside the Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001). The PGSI was also administered in Study 2 to assess for gambling problems. Using the information obtained from the CIDI and the SCID-5, trained interviewers, and the principle investigators (clinical psychologists) assigned diagnoses for all participants (Shakeel et al., 2018). After completing the first session, participants were asked to complete the PID-5 at home on Qualtrics.

The second session was scheduled within two weeks of completing the first session. The focus of the second session was to administer a battery of cognitive assessments (e.g., Tower Task, Maintenance Manipulation Task, Stroop Color-Word Test, etc.). Self-report questionnaires
assessing mania and depression including changes in mood, appetite, suicidality, psychomotor activity, sleep and sexual functioning was assessed using the Young Mania Rating Scale (YMRS; Young, Biggs, Ziegler, & Meyer, 1978), and the Hamilton Depression Rating Scale (HAMD; Hamilton, 1960). Depending on the timing of the tasks (e.g., time lapse required between tasks), these questionnaires were randomly administered between cognitive tasks. Participants were debriefed and compensated $90 at the end of the studies.

3.3. Measures

As mentioned previously, in both studies, all participants completed a battery of cognitive measures and self-report questionnaires as a part of a broader program of research. For the purposes of this study, only the following questionnaires were used in the analyses: the CIDI (Kessler et al., 2008), the SCID-5, the YMRS (Young et al., 1978), the HAMD (Hamilton, 1960), the PGSI (Ferris & Wynne, 2001), and the PID-5 (Krueger et al., 2012).

3.3.1. Composite International Diagnostic Interview (CIDI)

The CIDI was developed by the World Health Organization (WHO), and is used as a structured diagnostic interview for the assessment of mental disorders based on the DSM-IV (Kessler et al., 2008; Kessler & Usten, 2004; Gelaye et al., 2013). The CIDI is comprised of 7 broad sections which assess the following: screening and lifetime review (discussed below), disorders (mood, anxiety, substance-abuse, childhood and other disorders (e.g. pathological gambling, personality disorders), functioning and physical disorders (evaluates suicidality and psychological distress), treatment, risk factors (e.g. early life experiences), socio-demographics (e.g. employment, socioeconomic status), and the methodological (interviewer observations) section. The screening and lifetime review section provides subjects with “diagnostic stem questions” for core diagnoses. This section assesses a lifetime history of psychiatric diagnoses
without delving into the “branch” questions for each diagnosis. In addition, this section provides the researcher with a general understanding of the subject’s mental health history (Kessler & Usten, 2004).

It has been found that the CIDI (across studies using clinical and general populations), demonstrates acceptable inter-rate and test-retest reliability ($k > 0.40$) and that the diagnoses are significantly related to “independent clinical diagnoses” (Kessler et al., 1998; Kessler & Usten, 2004). In contrast, the validity of the CIDI is variable, and this could be a result of the difficult nature of evaluating the validity due to variability across studies. Nevertheless, in accordance with the DSM-III, it has been found that BD and Obsessive Compulsive Disorder (OCD) diagnoses have the highest validity, while major depression and substance use disorders have the highest reliability (Romera et al., 2002).

### 3.3.2. Structured Clinical Interview for DSM-5 Disorders (SCID-5)

The SCID-5 is a semi-structured interview, that assesses various psychiatric disorders including, mood disorders, schizophrenia spectrum and other psychotic disorders, substance use disorders, anxiety disorders, feeding and eating disorders, obsessive-compulsive and related disorders, trauma and stressor-related disorders, and adult ADHD. Similar to the CIDI, the SCID-5 begins with a general overview of demographic information and a lifetime history of psychiatric illnesses. The interviewer then goes through modules (categorized by diagnoses) that commence with “diagnostic stem” questions (which are based off of the diagnostic criteria for a disorder) and if the specific criteria are met for these questions, then the interviewer continues with that module, if the criteria is not met then the remaining questions for that module is skipped (Glasofer, Brown, & Riegel, 2015).
The SCID-5 has demonstrated good internal consistency, test-rest reliability, and superior concurrent and predictive validity for most disorders (Glasofer et al., 2015; Shankman et al., 2018). Importantly, the SCID-5 is thought to not only assess psychopathology “categorically”, but can also be used to assess common mental disorders “dimensionally” including depression, anxiety and substance-use disorders (Shankman et al., 2018).

3.3.3. Young Mania Rating Scale (YMRS)

The YMRS is an 11-item self-report questionnaire that assesses manic symptoms (elevated mood, increased motor activity-energy, sexual interest, sleep, irritability, speech (rate and amount), language-thought disorder, content, disruptive-aggressive behaviour, appearance, and insight). For four of the items, participants respond on a scale ranging from 0 to 8, the rest of the items are scored on a scale from 0 to 4 (all items have 5 options to choose from; Young et al., 1978). The YMRS total and individual items scores have demonstrated strong reliability and validity across populations experiencing symptoms of mania (Young et al., 1978).

3.3.4. Hamilton Depression Rating Scale (HAMD)

The HAMD is a 21-item semi-structured interview assessing severity of depressive symptoms (depressed mood, feelings of guilt, suicide, insomnia, work and activities, retardation, agitation, anxiety, somatic symptoms, genital symptoms, hypochondriasis, loss of weight, insight, diurnal variation, depersonalization and derealization, paranoid symptoms and obsessional and compulsive symptoms). Participants respond to items on a 5-point scale ranging from 0 (not present) to 4 (severe) for 8 items and on a scale from 0 to 2 for 9 items (Hamilton, 1960). The HAMD shows acceptable convergent and discriminant validity, internal consistency and test-retest reliability across populations (Zimmerman et al., 2013, González-Pinto et al., 2009).
3.3.5. Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001)

The PGSI is a widely used self-report questionnaire that was designed to assess the severity of problem gambling in the past 12 months in the general population. Participants are asked 9 questions and respond on a 4-point Likert scale ranging from 0 (never) to 3 (almost always). Examples of questions include: “How often have you gone back another day to try to win back the money you lost?” and “How often have you borrowed money or sold anything to get money to gamble?” (Holtgraves, 2009). The PGSI evaluates both problem gambling behaviour and adverse consequences (Holtgraves, 2009).

The PGSI has found to have acceptable correlations with measuring gambling frequency with problem and non-problem gamblers, however, there is a poor correlation found within samples of low to moderate problem gamblers (Currie, Hodgins, & Casey, 2013; Holtgraves, 2009; Miller, Currie, Hodgins, & Casey, 2013).

3.3.6. PID-5

The PID-5 questionnaire asks participants to rate statements about themselves on a Likert scale ranging from 0 (very false or often false) to 3 (very true or often true). Examples of statements include: “I don’t get as much pleasure out of things as others seem to.” “Plenty of people are out to get me.”, “I’ve been told that I spend too much time making sure things are exactly in place.” Scoring was based on DSM-5 instructions: scores from each item were computed for each personality trait facet, (e.g. for “Anhedonia”, items #1, #23, #26, #30, #124, #155, #157 and #189 were summed), then, personality trait domain scores were computed using the total scores from the personality trait facet scores (e.g. for “Negative Affect”, scores from the following personality facets will be summed: emotional lability, anxiousness and separation insecurity). For items that were missing, (unanswered statements) a prorated score was computed.
by summing the number of items that were answered to get a partial raw score. The partial raw score was then multiplied by the total number of items contributing to that facet (i.e., 4-14), the resulting value was divided by the number of items that were actually answered to obtain the prorated total or domain raw score. It is important to note that not all the personality facets are computed to produce the total personality domain score (refer to Table 6).

The internal consistencies of the PID-5 domain trait scales demonstrate acceptable to good reliability: Negative Affect \( \omega = .84 \); Detachment \( \omega = .75 \); Psychoticism \( \omega = .87 \); Antagonism \( \omega = .83 \); and Disinhibition \( \omega = .80 \). In addition, facet scales within each domain are strongly correlated (Quilty et al., 2013; Fowler et al., 2017). As a whole, studies support the hypothesis that the PID-5 is a reliable instrument which is able to cover both DSM-IV personality domains and personality pathology in the DSM-5 (Fossati et al., 2013). More notably, basic psychometric properties of the scale are replicated in different samples, the PID-5 domains and facets are proved to be significant predictors of psychopathology and baseline symptoms, and the PID-5 domain and facet scales are strongly associated with the NEO PI-R domain scales (Fossati et al., 2013; Quilty et al., 2013; Fowler et al., 2017).

3.4. Statistical Analyses

All data analyses were carried out using IBM SPSS™ 24.0. In order to examine mean-level differences, and the magnitude of these differences across diagnostic and control groups for each PID-5 domain, a one-way multivariate analyses of covariance (MANCOVAs) (with age and sex as covariates) were conducted in both studies (Field, 2013). Assumptions, including multivariate normality, and homogeneity of covariance matrices were checked for violations using Box’s test of equality of covariance matrices and Levene’s test of equality of error covariances. Variables were examined for univariate outliers, which were identified as z-scores
greater than 3 standard deviations above or below the mean (Tabachnick & Fidell, 2013). Due to the small sample size in both studies, Pillai’s trace was used as the most appropriate test statistic, because prior research shows that Pillai’s trace is the most robust against violations of assumptions (Field, 2013). Depending on the significance of the multivariate tests, discriminant function analyses (DFAs) were conducted to determine which PID-5 domains best differentiated between the diagnostic and control groups. In addition, following the DFAs, to examine which set of PID-5 facet scales best discriminated between groups, a DFA including all facet scales of the top two contributing domains in the previous analysis as possible predictors were conducted (Bastiaens et al., 2019). Moreover, to investigate which facet scales contributed the most to the differentiation between both groups, a stepwise DFA for all PID-5 domains were conducted using the facets as predictors to determine which facets would be retained (Bastiaens et al., 2019). Moreover, bivariate correlations were conducted on HAMD, YMRS, PGSI, and the PID-5 questionnaires. The magnitude of the effect sizes were estimated through Cohen’s $d$ coefficient ($|d| > 0.20$ is considered to be a small effect size, $|d| > 0.50$ is considered to be a moderate effect size and $|d| > 0.80$ is considered to be a large effect size; Cohen, 1988), through a 95% confidence interval.

4. Results

4.1. Demographics and Descriptive Data for Study 1

A total of 97 participants were recruited for the study (GD participants [$n = 47$] and respective controls [$n = 50$]). After a thorough screening of participants (based on the exclusion criteria discussed in “Participant Recruitment”), 33 GD participants (23 males and 10 females) and 38 controls (13 males and 25 females) were eligible for the study. All individuals with the following comorbidities were eligible to complete the study: 2 GD participants who identified as
having been diagnosed with a substance use disorder over the past 12 months, 3 GD participants who were diagnosed with either a specific phobia, a binge eating disorder or another eating disorder, and 3 GD participants who were either diagnosed with a panic disorder, and social anxiety. The mean age of the GD sample was 43.76 ($SD = 15.57$) years old, and the mean age of the control sample was 42.39 ($SD = 14.31$) years old (for demographics information please refer to Tables 17 and 18).

For the GD group, Cronbach’s alpha values for all PID-5 facet scales ranged from 0.56 to 0.95, and for all PID-5 domain scales Cronbach’s alpha values were greater than 0.80. For the control group, Cronbach’s alpha values for all PID-5 facet scales ranged from 0.59 to 0.93, and for all PID-5 domain scales Cronbach’s alpha values were greater than 0.87. The high Cronbach’s alpha values for the PID-5 domains, as well as most of the PID-5 facet scales indicate adequate internal consistency. There were no univariate outliers present.

4.2. Demographics and Descriptive Data for Study 2

A total of 47 participants were recruited for the study (BD participants [$n = 24$] and respective controls [$n = 23$]). After a thorough screening of participants (based on the exclusion criteria discussed in “Participant Recruitment”), 18 BD participants (5 males and 13 females) and 19 controls (8 males and 11 females) were eligible to complete the study. All individuals with the following comorbidities were eligible to complete the study: 3 BD participants who identified as having been diagnosed with a substance use disorder over the past 12 months. In addition, there was 1 participant who was diagnosed with general anxiety disorder. The mean age of the BD sample was 37.00 ($SD = 11.74$) years old, and the mean age of the control sample was 38.53 ($SD = 10.98$) years old (for demographics information please refer to Tables 19 and 20).
For the BD group, Cronbach’s alpha values for all PID-5 facet scales ranged from 0.60 to 0.98, and for all PID-5 domain scales Cronbach’s alpha values were greater than 0.93. For the control group, Cronbach’s alpha values for all PID-5 facet scales ranged from 0.36 to 0.95, with the exception of the Unusual Beliefs and Experiences facet, where the Cronbach’s alpha was quite low at 0.18. However, for all PID-5 domain scales Cronbach’s alpha values were greater than 0.62. The high Cronbach’s alpha values for the PID-5 domains, as well as most of the PID-5 facet scales demonstrate adequate internal consistency. There were no univariate outliers present.

4.3. Study 1: MANCOVA Results

A MANCOVA was conducted with diagnostic group as the independent variable and the PID-5 domains as the dependent variables (Bastiaens et al., 2019). Multivariate tests found a significant main effect of sex on the PID-5 domain scores, \( V = 0.23, F(5, 65) = 3.79, p = 0.005, \) partial \( \eta^2 = 0.23; \) thus, sex was entered as a covariate in the subsequent analyses. While there was not a significant effect of age on the PID-5 domain scores, it was entered as a covariate in the analyses to control for the large age range (18-75 years old). Box’s test of equality of covariance matrices revealed a non-significant test result (\( p > 0.001 \)). Levene’s test of equality of error covariances also revealed non-significant values for all PID-5 domains (Negative Affect: \( p = 0.055 \); Detachment: \( p = 0.411 \); Antagonism: \( p = 0.904 \); Disinhibition: \( p = 0.442 \); Psychoticism: \( p = 0.003 \)). Thus, multivariate normality and homogeneity of covariance were not violated. Using Pillai’s trace, there was a significant group difference on PID-5 domains of GD and control participants, \( V = 0.23, F(5, 63) = 3.85, p = .004 \) (see Figure 1). In the tests of between-subject effects, significant main effects of groups were found on all PID-5 domains except Antagonism (see Table 7). GD participants scored on average, significantly higher than all of the control participants on all PID-5 domains. The effect sizes for all the PID-5 domains ranged from
medium to large. (Please refer to Table 8 for the estimated marginal means of the domains by group and corresponding effect sizes.)

4.4. Study 2: MANCOVA Results

Box’s test of equality of covariance matrices revealed a significant test result \( p < 0.001 \), and Levene’s test of equality of error covariances also revealed significant test results on most PID-5 domains (Negative Affect: \( p < 0.001 \); Detachment: \( p = 0.097 \); Antagonism: \( p = 0.202 \); Disinhibition: \( p < 0.001 \); Psychoticism: \( p < 0.001 \)). As a result of the small sample size, and the positive skewness of the data (mean scores were larger than the median scores of the PID-5 domains), data were log transformed to ensure assumptions of multivariate normality, and homogeneity of covariance matrices were not violated. Before the data were log transformed, it should be noted that the pairwise comparisons revealed significant differences in the following PID-5 domains: Negative Affect, Detachment, Disinhibition, and Psychoticism. After the data (PID-5 domain and facet scores) were log transformed, assumptions of multivariate normality, and homogeneity of covariance matrices were not violated, as Box’s test of equality of covariance matrices revealed a non-significant test result \( p > 0.001 \), and Levene’s test of equality of error covariances revealed non-significant values for all PID-5 domains (Negative Affect: \( p = 0.077 \); Detachment: \( p = 0.116 \); Antagonism: \( p = 0.244 \); Disinhibition: \( p = 0.003 \); Psychoticism: \( p = 0.004 \)) as well. Multivariate tests found a significant main effect of sex on the PID-5 domain scores, \( V = 0.35, F(5, 31) = 3.36, p = 0.015 \), partial \( \eta^2 = 0.35 \), thus sex was entered as a covariate in the subsequent analyses. While there was not a significant effect of age on the PID-5 domain scores, it was entered as a covariate to control for the large age range (21-60 years old). It should be noted that the significant pairwise comparisons identified earlier (before the log transformation) remained unchanged. Using Pillai’s trace, there was a significant
group difference on BD and control participants, $V = 0.52, F(5, 31) = 6.84, p = .0002$ (see Figure 2). In the tests of between-subject effects, significant main effects of groups were found on all PID-5 domains except Antagonism (see Table 7). BD participants scored on average, significantly higher than all of the control participants on all PID-5 domains. The effect sizes for all the PID-5 domains ranged from small to large. Refer to Table 8 for the estimated marginal means of the domains by group and corresponding effect sizes.

4.5. Discriminant Function Analyses on PID-5 Domains

**Study 1: Gambling Participants vs. Community Controls**

The MANCOVA was followed up with discriminant function analyses (DFAs). While the MANCOVA predicts a set of outcome measures from a grouping variable, the discriminant analysis predicts the grouping variable from a set of outcome measures (PID-5 domains), this analysis is comparable to that of a logistic regression (Field, 2013). A DFA was conducted to determine which of the PID-5 domains best differentiated between both the GD and control group. The structure matrix (canonical variate correlation, which indicates that values with high correlations contribute the most to group separation) demonstrated that Disinhibition best discriminated between both groups, followed by Negative Affect, Psychoticism, Antagonism, and Detachment (Table 9). PID-5 domains classified participants into their respective groups with an accuracy of 76.1% (Wilks’s $\Lambda = .74, p=.001$, canonical correlation $= 0.51$).

**Study 2: Bipolar Participants vs. Community Controls**

Similarly, a DFA was conducted to determine which of the PID-5 domains best differentiated between both the BD and control group. The structure matrix (canonical variate correlation) demonstrated that Disinhibition best discriminated between both groups, followed by Psychoticism, Negative Affect, Detachment, and Antagonism. (Table 9). PID-5 domains
classified participants with an accuracy of 92.0% (Wilks’s Λ = .48, \( p = .0002 \), canonical correlation = 0.72).

4.6. Function Discriminant Analyses on PID-5 Facets

**Study 1: Gambling Participants vs. Community Controls**

In order to determine which set of PID-5 facet scales best discriminated between both groups, a DFA was conducted on facet scales of the top two contributing domains (Disinhibition and Negative Affect) in the previous analysis. Only the top two domains were chosen to conduct the facet-level because of the initial hypotheses. The structure matrix (canonical variate correlation) demonstrated that for the domain Disinhibition, the facet Impulsivity contributed the most to discriminating between both groups, followed by Irresponsibility, and Distractibility (Table 10). The facets of Disinhibition classified participants with an accuracy of 74.6% (Wilks’s Λ = .73, \( p = .0001 \), canonical correlation = 0.52). For the domain, Negative Affect, the structure matrix revealed that the facet Anxiousness contributed the most to discriminating between both groups, followed by Separation Insecurity, and Emotional Lability (Table 10). The facets of Negative Affect classified participants with an accuracy of 69.0% (Wilks’s Λ = .83, \( p = .007 \), canonical correlation = 0.41).

**Study 2: Bipolar Participants vs. Community Controls**

Similarly, a DFA was conducted on facet scales of the top two contributing domains (Disinhibition and Psychoticism) in the previous analysis. Only the top two domains were chosen to conduct the facet-level because of the initial hypotheses. The structure matrix (canonical variate correlation) demonstrated that for the domain Disinhibition, the facet Distractibility contributed the most to discriminating between both groups, followed by Impulsivity, and Irresponsibility (Table 10). The facets of Disinhibition classified participants with an accuracy of
83.8% (Wilks’s Λ = .44, p < .0001, canonical correlation = 0.75). For the domain, Psychoticism, the structure matrix revealed that the facet Perceptual Dysregulation contributed the most to discriminating between both groups, followed by Unusual Beliefs and Experiences, and Eccentricity (Table 10). The facets of Psychoticism classified participants with an accuracy of 89.2% (Wilks’s Λ = .51, p < .0001, canonical correlation = 0.70).

4.7. Step-wise Discriminant Analyses on all PID-5 Facets

**Study 1: Gambling Participants vs. Community Controls**

Subsequently, a stepwise DFA was conducted on all facets of the PID-5 domains (excluding Antagonism). Only the Impulsivity (belonging to the Disinhibition domain), and Anhedonia (belonging to the Detachment domain) facets were retained (canonical correlation = 0.55, Wilks’s Λ = .70, p < .0001; refer to Table 11). Both facets, Impulsivity and Anhedonia, correlated positively with the discriminant function (r = 0.44 and r = 0.82, respectively). Participants were classified correctly into their respective groups with an accuracy of 73.2%.

**Study 2: Bipolar Participants vs. Community Controls**

Similarly, a stepwise DFA was conducted on all facets of the PID-5 domains (excluding Antagonism). Only the Distractibility (belonging to the Disinhibition domain), and Perceptual Dysregulation (belonging to the Psychoticism domain) facets were retained (canonical correlation = 0.77, Wilks’s Λ = .40, p < .0001; refer to Table 12). Both facets, Distractibility and Perceptual Dysregulation, correlated positively with the discriminant function (r = 0.67 and r = 0.51, respectively). Participants were classified correctly into their respective groups with an accuracy of 86.5%.

4.8. Bivariate Correlations of Mood Symptomology and Personality Traits

**Study 1: Gambling Participants vs. Community Controls**
GD participants did not endorse significant symptoms of mania on the YMRS. Regarding the HAMD, 2 GD participants endorsed having symptoms of mild depression, and 2 participants endorsed having symptoms of severe depression. On the PGSI, all GD participants scored a minimum of 1 (indicating low level of problems with few or no identified negative consequences), and a maximum of 26 (problem gambling with negative consequences and a possible loss of control). It should be noted that 1 community control endorsed having moderate levels of problem gambling leading to some negative consequences (score of 4).

Correlations (Pearson R) for personality traits, depressive, and mania symptoms and gambling severity are presented in Tables 13 and 14. For GD participants, there were no significant correlations between the HAMD, YMRS, PGSI and the PID-5 domains. However, there was a positive correlation between the YMRS and the HAMD. In regards to the PID-5 domains, Negative Affect was positively correlated with Antagonism, Disinhibition, and Psychoticism. In addition, Antagonism was positively correlated with Disinhibition and Psychoticism, and Disinhibition was also positively correlated with Psychoticism (refer to Table 13). For community controls, almost all of the PID-5 domains were positively correlated with each other except for the domains Detachment and Antagonism. HAMD was positively correlated with the PID-5 domain, Detachment, and the YMRS was positively correlated with Negative Affect, Detachment, Psychoticism, and the HAMD. Finally, the PGSI was positively correlated with both the HAMD and the YMRS (refer to Table 14).

**Study 2: Bipolar Participants vs. Community Controls**

BD participants scored a 9 or less on the YMRS indicating a remission regarding manic symptoms. Regarding the HAMD, 1 BD participant endorsed having symptoms of mild depression, another BD participant endorsed having symptoms of moderate depression, and 3
BD participants endorsed having symptoms of severe depression. On the PGSI, 3 BD participants scored a 6 or higher indicating that they had moderate to high levels of gambling problems leading to negative consequences and a possible loss of control. Due to the small sample size, these participants were not excluded from the study.

Correlations (Pearson R) for personality traits, depressive, and manic symptoms and gambling severity are presented in Tables 15 and 16. For BD participants, there was a positive correlation between the HAMD and Negative Affect, the YMRS and Detachment, and between the PGSI and Disinhibition. In regards to the PID-5 domains, Negative Affect was positively correlated with Detachment, Disinhibition, and Psychoticism. In addition, Detachment was positively correlated with Antagonism, Disinhibition and Psychoticism, and Disinhibition was also positively correlated with Psychoticism (refer to Table 13). For community controls, there were no significant correlations between the HAMD, YMRS, PGSI and the PID-5 domains. However, Negative Affect was positively correlated with Detachment and Disinhibition, Detachment was positively correlated with Disinhibition, Antagonism was positively correlated between Disinhibition and Psychoticism, and lastly Disinhibition was also positively correlated with Psychoticism.

5. Discussion

Utilizing the personality inventory for DSM-5 (PID-5), these studies aimed to investigate whether pathological personality traits can discriminate between GD, BD and their respective controls. In the past, the literature focused primarily on the relationship between personality traits and psychiatric conditions, and largely excluded healthy controls in these comparisons (e.g., Heath et al., 2018; Bastiaens et al., 2016; Bastiaens et al., 2019). To our knowledge, this is the first study to use pathological personality dimensions to evaluate the relationship between a
diagnostic group (with a mood and addictive disorder characterized by impulsivity) and their respective age-matched controls.

A secondary aim of this study was to examine which of the PID-5 domains best distinguish between a diagnostic group and community controls, and which of the PID-5 facet scales best discriminate within each of those significant domains. This is important considering that BD and GD patients have shared personality traits such as significantly higher levels of impulsivity (Shakeel et al., 2018). Prior research demonstrates that pathological personality traits and facets associated with psychiatric disorders can predict baseline symptoms better than demographics, comorbidities, and neuropsychological tests (Fowler et al., 2015; Forbush et al., 2008). Therefore, an assessment of personality functioning and pathological personality traits are considered important and perhaps even necessary (American Psychiatric Association, 2013; Forbush et al., 2008; Fowler et al., 2017).

**Study 1: Gambling Participants vs. Community Controls**

After controlling for sex and age, the multivariate tests revealed significant group differences between GD participants and controls on four of the five PID-5 domains: Negative Affect, Detachment, Disinhibition and Psychoticism. This is in keeping with the initial hypotheses and past research showing that these same PID-5 domains discriminate between a clinical sample and community controls (Bach et al., 2018; Heath et al., 2018). Findings from Bach et al., (2018) showed no significant differences for the Antagonism domain for outpatients from a psychiatric hospital with a non-psychotic mental disorder and community controls (see also Heath et al., 2018 and Pires et al., 2019). Yet, prior research also reveals significant differences between clinical samples and healthy controls across all domains (Rowiński et al., 2019). The failure of the Antagonism domain to discriminate between GD participants and
controls could be attributed to the fact that GD participants with comorbidities (other than psychotic disorders) were eligible to participate. More specifically, GD individuals with substance use disorders, and control participants who endorsed the consumption of alcohol, cannabis, and other substances may have influenced this outcome. Indeed, studies have found that the domains of Antagonism and Disinhibition are able to significantly predict problematic drug and alcohol use (Creswell et al., 2016; Few et al., 2013). By briefly examining an unstandardized substance use questionnaire (developed by Dr. Hodgins’ lab), which was administered to all participants, it was noted that many of the community controls regularly consumed alcohol and other substances; this consumption may have in fact affected the sensitivity of the Antagonism domain in distinguishing between GD and control participants.

As previously mentioned, GD participants scored higher than all of the community controls on the PID-5 domains, and there were significant differences on four of the five domains. More notably, GD participants scored the highest on the Negative Affect domain followed by Disinhibition, Detachment, Antagonism, and Psychoticism. These domain scores are consistent with past literature showing problem gamblers scoring higher on the Negative Affect domain compared to the Disinhibition domain, as well as scoring higher on most maladaptive personality traits relative to their respective controls (Nigro et al., 2018; Carlotta et al., 2015). Furthermore, in a sample of personality disorder (PD) patients (whose symptoms also include elevated levels of impulsivity), obtained the highest scores on the Negative Affect domain (Torres-Soto, Moya-Faz, Giner-Alegria & Oliveras-Valenzuela, 2019). Perhaps the high scores on the Negative Affect domain speaks to the significant relationship between emotion dysregulation and elevated levels of impulsivity with the development of addictions (Schreiber, Grant, & Odlaug, 2012).
However, it was predicted that problem gamblers would score the highest on the Disinhibition domain, considering this domain is comprised of the following facets: Distractibility, Impulsivity, and Irresponsibility; these are all personality traits that significantly predict problem gambling behaviours (Shakeel et al., 2018; Walther, Morgenstern, & Hanewinkel, 2012; Carlotta et al., 2015). In addition, studies show that the decision to continue to gambling (chasing) is strongly associated with the Disinhibition domain (Nigro et al., 2018).

Nonetheless, subsequent DFA analyses revealed that while participants scored the highest on the Negative Affect domain, the Disinhibition domain best discriminated between the GD and control group, followed by Negative Affect, Psychoticism, Antagonism and Detachment domains. The DFA also revealed that the PID-5 domains accurately classified participants into their respective groups. Given that pathological gambling behaviour can be difficult to diagnose at early stages without examining factors such as comorbidities and family history, the DFA underscores the importance of using pathological personality traits to assist with discriminating between pathological problem gambling and “normative” gambling behaviours.

Overall, the Disinhibition domain best distinguished between GD participants and community controls and, in fact, the facet of Impulsivity contributed the most to this discrimination followed by Irresponsibility and Distractibility. This result is not surprising given that pathological gambling was classified as an impulse-control disorder in the past, and that there is a well-established relationship between gambling severity and elevated levels of impulsivity (Alessi & Petry, 2009; Shakeel et al., 2018; Mestre-Bach et al., 2018). In fact, in a study conducted by Rogier & Bizzi, (2018), the Disinhibition domain was the only significant predictor of GD severity.
Followed by Disinhibition, the Negative Affect domain best discriminated between the groups, with the facet of Anxiousness contributing most to this discrimination followed by Separation Insecurity, and Emotional Lability. It has been established that Negative Affect is akin to the Neuroticism domain of the FFM personality trait (Carlotta et al., 2015). Moreover, pathological gambling has been strongly associated with Neuroticism, as studies in the past have shown pathological gamblers scoring significantly higher on the Neuroticism domain compared to non-pathological gamblers (Bagby et al., 2007; Myrseth et al., 2009). Thus, the findings are consistent with past literature demonstrating a strong relationship between Negative Affect and problem gambling. However, past findings also revealed heightened levels of psychoticism in GD individuals (Bagby et al., 2007; Myrseth et al. 2009). While these studies did not utilize the PID-5 to assess psychoticism, the questionnaire that they utilized did in fact show a high correlation between psychoticism and a specific form of impulsivity (Nower, Derevensky, & Gupta, 2004). Thus, future studies should investigate how the PID-5 domain of Psychoticism is correlated with the specific forms of impulsivity, especially because in the present study, the Disinhibition and Psychoticism domains were positively correlated. This may even account for why the Psychoticism domain discriminated between groups more than the Antagonism and Detachment domains.

Of note, the relationship between mood states, specifically negative emotions, and impulsive behaviors have been well-studied (e.g., Herman, Critchley, & Duka, 2018; Tomko et al., 2015). For instance, in a study conducted by Herman et al., (2018), it was found that negative mood states were related to higher scores on impulsive measures. From this perspective, the relationship between negative affect and impulsivity in the present study could account for why the Negative Affect domain was one of the top discriminating domains between the GD and
control group. Interestingly, Anxiousness contributed the most to the Negative Affect domain in this discrimination. This is interesting in that, although there is a gap in the literature outlining the relationship between specific facets of maladaptive personality traits and pathological gambling, it is common for individuals to turn to gambling to alleviate symptoms of depression and anxiety (Clark, 2014). In the current study, 4 GD participants endorsed having symptoms of mild to severe depression, symptoms that may have influenced the presentation of Anxiousness as the most prominent distinguishing factor in the Negative Affect domain.

There are a few discrepancies with findings from past literature comparing gamblers with groups other than community controls, specifically high risk gamblers to low risk gamblers. For instance, high risk GD individuals showed significant associations with Detachment and Antagonism relative to low risk GD (Carlotta et al., 2015). It is interesting to see that when one compares these clinical samples with other conditions, the domains that distinguish between these diagnostic groups changes. These findings highlight the importance of using community controls in these comparisons because we are able to contribute to knowledge regarding the clinical presentation of these normative and pathological gambling behaviours. When a stepwise DFA on all facets were conducted only two facets were retained: Impulsivity and Anhedonia. While Impulsivity was expected to be retained, Anhedonia was not. However, this could be a result of the endorsement of depressive symptoms by the GD participants. As mentioned, anxiousness contributed most to the Negative Affect domain in its discrimination of groups, and it is well known that depression and anxiety are commonly comorbid. Altogether, these results point to the importance of evaluating mood states in the underlying mechanisms of pathology in GD, or contributing to the development of GD.
Notably, the internal reliability of the PID-5, evaluated by Cronbach’s alphas, indicated good internal consistency between the GD and control groups for all the PID-5 domains. However, the Cronbach’s alpha values for the facets of submissiveness and suspiciousness were quite low (α <0.60). That said, these PID-5 facets have frequently been shown to have low internal consistencies in both clinical and community samples (Pires et al., 2019; Gutiérrez et al., 2017).

To conclude, the top domains (Disinhibition and Negative Affect), and their respective facets that contributed to the discrimination of groups, is consistent with literature that states that pathological gambling is a result of the combination of elevated levels of impulsivity and emotional vulnerability (Bagby et al., 2007).

**Study 2: Bipolar Participants vs. Community Controls**

After controlling for sex and age, the multivariate tests revealed significant group differences between BD participants and controls on four of the five PID-5 domains: Negative Affect, Detachment, Disinhibition and Psychoticism. This is in keeping with the initial hypotheses and past research showing that at least four of the five PID-5 domains (Negative Affect, Detachment, Disinhibition, and Psychoticism) discriminate between individuals diagnosed with psychotic disorders and other psychiatric conditions (including Depressive, Bipolar, and Alcohol Use Disorders; Heath et al., 2018; Bastiaens et al., 2019). The failure of the Antagonism domain to discriminate between BD participants and controls may be attributed to the fact that “delusions of grandeur” as they present in BD are often associated with the Psychoticism domain (as shown with participants with psychotic disorders; Watson, Stasik, Ro, & Clark, 2013; Bastiaens et al., 2019). In addition, prior research shows that the Antagonism domain fails to differentiate between patient psychiatric samples and healthy controls (Watson et
al., 2013; Bastiaens et al., 2019). Thus, these results are consistent with past literature showing the failure of the Antagonism domain to distinguish between clinical samples and healthy controls.

Similar to the GD participants in Study 1, BD participants scored the highest on the Negative Affect domain followed by Disinhibition, Psychoticism, Detachment, and Antagonism. This pattern is inconsistent with past literature showing BD individuals scoring the highest on the Detachment domain, followed by Psychoticism, Negative Affect, Disinhibition, and Antagonism (Heath et al., 2018). However, this could be attributed to the fact that many of the BD participants exhibited depressive symptoms (Heath et al., 2018). In addition, as the Negative Affect domain is akin to that of the Neuroticism domain, these domain scores are also consistent with a study conducted by Sparding et al., (2017), showing a group of BD individuals scoring the highest on the Neuroticism domain. In the present study, while none of the BD participants endorsed significant symptoms of mania on the YMRS, a few participants indicated symptoms of depression, as well as incidences of negative consequences following problem gambling. The difference in symptomologies of these BD samples (compared to other studies) along with the influence of differential factors such as stress, problem gambling, etc., could account for the discrepancies in the scores on the PID-5 domains.

On the contrary, subsequent analyses (DFAs) demonstrated that while BD participants scored the highest on the Negative Affect domain, the Disinhibition domain best discriminated between the BD and control group, followed by Psychoticism, Negative Affect, Detachment, and Antagonism. The DFA also revealed that the PID-5 domains were able to classify participants into their respective groups very accurately. These results were unexpected given that prior research shows BD individuals scored the highest on the Detachment domain compared to other
psychiatric conditions (Heath et al., 2018), and that Detachment was found to be the domain that discriminated best between patients with or without psychosis (Bastiaens et al., 2019). However, these results are in line with research suggesting that BD individuals reported having heightened impulsive tendencies relative to healthy controls even during periods of euthymia, and at the facet level, impulsivity has been found to significantly differentiate between mood disorder diagnoses (Powers et al., 2013; Strakowski et al., 2010; Quilty et al., 2013b). Furthermore, in the present study, the bivariate correlations revealed a positive correlation between the PGSI and the Disinhibition domain; the fact that some BD participants endorsed items on the PGSI symptoms may account for why the Disinhibition domain best discriminated between both groups.

Unlike Study 1, the Distractibility facet contributed the most to the discrimination between the BD group and community controls, followed by Impulsivity and Irresponsibility. Distractibility has been found to contribute to the development of other symptoms of BD including the inability to sustain attention, deficits in verbal declarative memory, and executive functioning (Fleck, Shear, & Strakowski, 2009). In addition, emotional distractibility has been found to contribute to an increase in neuropsychological deficits in BD patients (Kanske et al., 2013). Thus, it is essential to examine the relationship between distractibility and impulsivity. Indeed, a study examining this relationship in a subclinical population of ADHD students found that individuals who demonstrated high levels of distractibility made more impulsive choices on behavioural tasks (Skogsholm, 2011). Perhaps, in BD patients, distractibility leads to more impulsive tendencies, and this could account for why the Distractibility facet discriminated the groups more than the Impulsivity facet. This finding is consistent with a study conducted by Bastiaens et al., (2019), which demonstrated that for the Disinhibition domain, Distractibility contributed the most to the differentiation between psychotic and non-psychotic participants.
Nevertheless, future studies should work on elucidating the relationship between distractibility and impulsivity in a sample of BD patients.

Followed by Disinhibition, the Psychoticism domain also discriminated between both groups quite well, with the facet of Perceptual Dysregulation contributing the most to this discrimination, followed by Unusual Beliefs and Experiences and Eccentricity. In a study examining personality traits of patients diagnosed with unipolar and bipolar disorder there were no significant differences between both groups in the Psychoticism domain; however, when compared to healthy individuals the Psychoticism domain differentiated both groups (Skapska-Sarius et al., 2003). Although the study did not utilize the PID-5 to assess psychoticism, the findings speak to how robust personality traits involving features of psychoticism distinguish between affective disorder patients and healthy individuals.

Despite the complex relationship between Psychoticism (of the PID-5), and the Openness to Experience domain of the FFM personality trait (Heath et al., 2018), some argue that Psychoticism is akin to that of the Openness to Experience domain (Watson et al., 2013). Therefore, the finding that BD patients scored significantly higher than recovered unipolar depressed patients on the Openness domain (Bagby et al., 1996; Quilty et al., 2013b), is consistent with the findings from the present study showing that the Psychoticism domain best discriminated between BD participants and controls. From this perspective, study of the relationship between Psychoticism and specific forms of impulsivity would seem an important focus for future research, especially because in the present study, the Disinhibition and Psychoticism domains were positively correlated. This may even account for why the Psychoticism domain discriminated between groups more than the Antagonism and Detachment domains.
Interestingly, Perceptual Dysregulation contributed the most to the Psychoticism domain in this discrimination. There is a gap in the literature outlining the relationship between specific facets of maladaptive personality traits and symptoms of BD. Yet, one can see how an individual with BD can experience unusual thought processes and experiences, including depersonalization, derealization, and dissociative experience during manic episodes (Krueger & Markon, 2014).

However, there are a few discrepancies with findings from past literature comparing BD individuals to populations diagnosed with other psychiatric conditions (specifically Axis I disorders). For instance, BD individuals scored significantly higher on Detachment than the Psychotic or Alcohol use Disorder groups (Heath et al., 2018). However, this is in keeping with past research showing mood disorders being associated with higher Extraversion (and Agreeableness) predicting BD verses unipolar depression (Quilty et al., 2013b).

These results also highlight the importance of using community controls in these comparisons, because while it is important to evaluate personality traits between diagnostic groups, it is critical to also distinguish between normative and maladaptive shifts in mood states. When a stepwise DFA on all facets were conducted, only two facets were retained: Distractibility and Perceptual Dysregulation. These facets were expected to be retained as they contributed most to the discrimination of the groups in their respective domains. This indicates that there may be an underlying relationship between disinhibition and psychoticism, something that would warrant examination in future studies.

The internal reliability of the PID-5 was evaluated through Cronbach’s alphas. Both the BD and control groups indicated good internal consistency for all the PID-5 domains. However, the Cronbach’s alpha values for the following facets for control participants were quite low (α <0.60): callousness, grandiosity, impulsivity, intimacy avoidance, irresponsibility, perceptual
dysregulation, suspiciousness, and unusual beliefs. Nevertheless, some of these facets (e.g., suspiciousness, irresponsibility, intimacy avoidance, and impulsivity) have frequently been shown to have low internal consistencies in both clinical and community samples (Pires et al., 2019; Gutiérrez et al., 2017). In addition, the low Cronbach’s alpha values for these facets may be attributed to the small sample size.

Based on the aforementioned studies, it is interesting to see how the PID-5 domains differentiate between a diagnostic group and their respective controls. In both studies, Disinhibition was the domain that best discriminated between the clinical samples and community controls. This is a testament to the importance of evaluating specific forms of impulsive behaviours, and how these behaviours manifest and relate to pathological personality traits. In Study 1, the Impulsivity facet contributed the most to the discrimination between groups, and in Study 2, the Distractibility facet contributed the most to this discrimination. The identification of these specific domains and facets sheds light on the shared and differential personality traits of addictive and mood disorders.

Personality traits are important to examine because they influence executive functioning processes, such as decision making. For instance, Kim & Lee (2011), demonstrated that the association between personality traits and the probability of winning, influence decision-making in problem gamblers. As such, these pathological personality traits can inform the clinical presentation and symptomology of these disorders across conditions, thereby making the development of transdiagnostic treatments feasible and perhaps easier to identify and implement.

5.1. Limitations

One limitation of the current study, as with many past studies, is the reliance on retrospective, self-report questionnaires for assessing personality traits. In an attempt to
circumvent this issue, different measures of personality (e.g., NEO-PI-R assessing FFM personality traits) could be used to arrive on convergent results, especially because there is a well-established relationship between most of the domains of the PID-5 and the personality traits on the NEO-PI-R (Helle & Mullins-Sweatt, 2019).

An additional limitation of the current study is the small sample sizes, especially in Study 2. As a result, the data violated the central limit theorem and assumptions of normality. In fact, due to the small sample size, a few participants with comorbidities were included in the analyses which may have impacted the discrimination of the diagnostic group and respective community controls. The small sample sizes in Study 2 also contributed to why a direct comparison of the PID-5 traits between diagnostic groups was not examined. A direct comparison of both the GD and BD groups was also not conducted because of the large difference between sample sizes in both diagnostic groups. Furthermore, both studies were conducted at different time points, and were designed with different objectives in mind. As a result, a direct comparison between diagnostic groups may have been misleading and inaccurate.

Lastly, as the assessments for both studies were completed over two sessions, some of the second sessions were scheduled up to a month after the first session. During this time period a shift in mood states may have occurred; thus, collecting information on mood states may be particularly important given the relationship between mood states and pathological personality traits. For instance, BD is characterized by extreme shifts in mood, and mood states have been found to play a significant role in the development and maintenance of pathological gambling behaviour (Griffiths, 1995; Tomko et al., 2015). As both GD and BD individuals experience elevated levels of impulsivity, and negative mood states have been associated with higher scores
on impulsive measures, it would be critical to examine the level of negative and/or positive affect amongst participants (Herman et al., 2018).

6. Conclusion

In both studies, the Disinhibition domain of the PID-5 best discriminated between the diagnostic group and community controls. However, for Study 1 (GD participants and controls), Impulsivity contributed the most to the discrimination, and for Study 2 (BD participants and controls), Distractibility contributed the most to the discrimination. Therefore, even though individuals diagnosed with an addictive and/or mood disorder exhibit elevated levels of impulsivity, the PID-5 was able to differentiate which facets contributed the most to this distinction within the Disinhibition domain. These results provide insight into the etiology of both disorders, as the identification of the Impulsivity facet (for Study 1) and the Distractibility facet (for Study 2) contribute to the knowledge of the heterogenous nature of impulsive behaviours.

Notably, the results from this study provide insight into the importance of utilizing controls in the investigation of personality traits and psychopathology. Future studies examining the relationship between maladaptive personality traits and psychopathology should use healthy controls in these comparisons to contribute to the knowledge about normative and maladaptive impulsive behaviours. This could potentially assist with diagnostic accuracy, and the development of transdiagnostic personality targeted intervention programs (e.g., the Preventure Programme which was designed to target personality risk factors [hopelessness, anxiety sensitivity, impulsivity, and sensation seeking] for substance abuse; Conrod, 2016; Edalati, & Conrod, 2019). In addition, as the PID-5 has been shown to be associated with clinical constructs
it serves as an effective measure of personality psychopathology (Al-Dajani, Gralnick, & Bagby, 2016).

In conclusion, the DSM-5 personality trait model explicitly demonstrates the heterogenous nature of problem gamblers, and bipolar patients. The source of diagnostic inaccuracies and poor treatment planning is a result of a categorical diagnostic system where classification of these diagnoses is not based on the likely true dimensional representation of the psychopathology. Thus, these findings emphasize the clinical utility of the PID-5 in distinguishing between a diagnostic group (characterized by elevated levels of impulsivity) and healthy controls.
7. References


8. Appendix

Table 1. Five-Factor Model of Personality-FFM Description (Parks-Leduc, Feldman, & Bardi, 2015).

<table>
<thead>
<tr>
<th>Construct</th>
<th>Description: The extent to which individuals tend to be...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Openness to Experience</td>
<td>…curious, intellectual, imaginative, creative, innovative, and flexible (vs. closed-minded, shallow, and simple)</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>…helpful, good-natured, cooperative, sympathetic, trusting and forgiving (vs. rude, selfish, hostile, uncooperative, and unkind)</td>
</tr>
<tr>
<td>Extraversion</td>
<td>…sociable, talkative, optimistic, ambitious, assertive, reward-seeking, outgoing, and energetic (vs. introverted, shy, reserved, quiet and unadventurous)</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>…organized, responsible, dependable, neat, efficient, and achievement-oriented (vs. disorganized, lazy, irresponsible, careless, and sloppy)</td>
</tr>
<tr>
<td>Emotional Stability</td>
<td>…calm, self-confident, stable, resilient, and well-adjusted (vs. neurotic, nervous, insecure, fearful, and anxious)</td>
</tr>
</tbody>
</table>

Table 2. Five-Factor Model of Personality-FFM Traits

<table>
<thead>
<tr>
<th>Construct</th>
<th>Traits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Openness to Experience</td>
<td><strong>High:</strong> Perceptual dysregulation, unusual beliefs and experiences, eccentricity</td>
</tr>
</tbody>
</table>
| Agreeableness              | **Low:** Suspiciousness, grandiosity, deceitfulness, manipulativeness, callousness  
                          | **High:** Submissiveness                                                |
| Extraversion               | **Low:** Intimacy avoidance, withdrawal, restricted affectivity, anhedonia  
                          | **High:** Attention seeking                                             |
| Conscientiousness          | **Low:** Irresponsibility, distractibility, impulsivity, risk taking  
<pre><code>                      | **High:** Perseveration, rigid perfectionism                             |
</code></pre>
<p>| Emotional Stability        | <strong>High:</strong> Anxiousness, emotional lability, hostility, separation insecurity, depressivity |</p>
<table>
<thead>
<tr>
<th>Facets</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotional lability</td>
<td>Instability of emotional experiences and mood; emotions that are easily aroused, intense, and/or out of proportion to events and circumstances.</td>
</tr>
<tr>
<td>Anxiousness</td>
<td>Feelings of nervousness, tenseness, or panic in reaction to diverse situations; frequent worry about the negative effects of past unpleasant experiences and future negative possibilities; feeling fearful and apprehensive about uncertainty; expecting the worst to happen.</td>
</tr>
<tr>
<td>Separation insecurity</td>
<td>Fears of being alone due to rejection by—and/or separation from—significant others, based in a lack of confidence in one's ability to care for oneself, both physically and emotionally.</td>
</tr>
<tr>
<td>Submissiveness</td>
<td>Adaptation of one's behavior to the actual or perceived interests and desires of others even when doing so is antithetical to one's own interests, needs, or desires.</td>
</tr>
<tr>
<td>Hostility</td>
<td>Persistent or frequent angry feelings; anger or irritability in response to minor slights and insults; mean, nasty, or vengeful behavior.</td>
</tr>
<tr>
<td>Perseveration</td>
<td>Persistence at tasks or in a particular way of doing things long after the behavior has ceased to be functional or effective; continuance of the same behavior despite repeated failures or clear reasons for stopping.</td>
</tr>
<tr>
<td>Withdrawal</td>
<td>Preference for being alone to being with others; reticence in social situations; avoidance of social contacts and activity; lack of initiation of social contact.</td>
</tr>
<tr>
<td>Intimacy avoidance</td>
<td>Avoidance of close or romantic relationships, interpersonal attachments, and intimate sexual relationships.</td>
</tr>
<tr>
<td>Anhedonia</td>
<td>Lack of enjoyment from, engagement in, or energy for life's experiences; deficits in the capacity to feel pleasure or take interest in things.</td>
</tr>
<tr>
<td>Depressivity</td>
<td>Feelings of being down, miserable, and/or hopeless; difficulty recovering from such moods; pessimism about the future; pervasive shame and/or guilt; feelings of inferior self-worth; thoughts of suicide and suicidal behavior.</td>
</tr>
<tr>
<td>Restricted affectivity</td>
<td>Little reaction to emotionally arousing situations; constricted emotional experience and expression; indifference and aloofness in normatively engaging situations.</td>
</tr>
<tr>
<td>Suspiciousness</td>
<td>Expectations of—and sensitivity to—signs of interpersonal ill-intent or harm; doubts about loyalty and fidelity of others; feelings of being mistreated, used, and/or persecuted by others.</td>
</tr>
<tr>
<td>Manipulativeness</td>
<td>Use of subterfuge to influence or control others; use of seduction, charm, glibness, or ingratiating to achieve one's ends.</td>
</tr>
<tr>
<td>Deceitfulness</td>
<td>Dishonesty and fraudulence; misrepresentation of self; embellishment or fabrication when relating events.</td>
</tr>
<tr>
<td>Grandiosity</td>
<td>Believing that one is superior to others and deserves special treatment; self-centeredness; feelings of entitlement; condescension toward others.</td>
</tr>
<tr>
<td>Attention seeking</td>
<td>Engaging in behavior designed to attract notice and to make oneself the focus of others' attention and admiration.</td>
</tr>
<tr>
<td>Callousness</td>
<td>Lack of concern for feelings or problems of others; lack of guilt or remorse about the negative or harmful effects of one's actions on others.</td>
</tr>
<tr>
<td>Personality Trait</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Irresponsibility</td>
<td>Disregard for—and failure to honor—financial and other obligations or commitments; lack of respect for—and lack of follow-through on—agreements and promises; carelessness with others' property.</td>
</tr>
<tr>
<td>Impulsivity</td>
<td>Acting on the spur of the moment in response to immediate stimuli; acting on a momentary basis without a plan or consideration of outcomes; difficulty establishing and following plans; a sense of urgency and self-harming behavior under emotional distress.</td>
</tr>
<tr>
<td>Distractibility</td>
<td>Difficulty concentrating and focusing on tasks; attention is easily diverted by extraneous stimuli; difficulty maintaining goal-focused behavior, including both planning and completing tasks.</td>
</tr>
<tr>
<td>Risk taking</td>
<td>Engagement in dangerous, risky, and potentially self-damaging activities, unnecessarily and without regard to consequences; lack of concern for one's limitations and denial of the reality of personal danger; reckless pursuit of goals regardless of the level of risk involved.</td>
</tr>
<tr>
<td>Rigid perfectionism</td>
<td>Rigid insistence on everything being flawless, perfect, and without errors or faults, including one's own and others' performance; sacrificing of timeliness to ensure correctness in every detail; believing that there is only one right way to do things; difficulty changing ideas and/or viewpoint; preoccupation with details, organization, and order.</td>
</tr>
<tr>
<td>Unusual beliefs and experiences</td>
<td>Belief that one has unusual abilities, such as mind reading, telekinesis, thought-action fusion, unusual experiences of reality, including hallucination-like experiences.</td>
</tr>
<tr>
<td>Eccentricity</td>
<td>Odd, unusual, or bizarre behavior, appearance, and/or speech; having strange and unpredictable thoughts; saying unusual or inappropriate things.</td>
</tr>
<tr>
<td>Cognitive and perceptual dysregulation</td>
<td>Odd or unusual thought processes and experiences, including depersonalization, derealization, and dissociative experiences; mixed sleep-wake state experiences; thought-control experiences.</td>
</tr>
</tbody>
</table>

Table 4. Personality Inventory for DSM-5 (PID-5)

<table>
<thead>
<tr>
<th>Domains</th>
<th>Traits</th>
</tr>
</thead>
</table>
| I. Negative Affect | 1. Anxiousness  
|                  | 2. Emotional Lability  
|                  | 3. Hostility  
|                  | 4. Perseveration  
|                  | 5. Lack of Restricted Affectivity  
|                  | 6. Separation Insecurity  
|                  | 7. Submissiveness  
| II. Detachment    | 8. Anhedonia  
|                  | 9. Depressivity  
|                  | 10. Intimacy Avoidance  
|                  | 11. Suspiciousness  
|                  | 12. Withdrawal  |
### III. Antagonism
- 13. Attention seeking
- 14. Callousness
- 15. Deceitfulness
- 16. Grandiosity
- 17. Manipulativeness

### IV. Disinhibition
- 18. Distractibility
- 19. Impulsivity
- 20. Irresponsibility
- 21. Lack of Rigid Perfectionism
- 22. Risk Taking

### V. Psychoticism
- 23. Eccentricity
- 24. Perceptual dysregulation
- 25. Unusual beliefs and experiences

---

#### Table 5. Representation of the UPPS-P model of impulsivity in DSM-5 disorder diagnostic criteria (Modified from Um, Hershberger, Whitt, & Cyders, 2018)

<table>
<thead>
<tr>
<th>Three-factor model</th>
<th>DSM-5 disorder</th>
<th>Diagnostic criteria (DSM-5) (Specific Traits when agreement was reached between raters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urgency</td>
<td>Bipolar I/II disorder</td>
<td>B. During the period of mood disturbance and increased energy or activity… are present to a significant degree and represent a noticeable change from usual behaviors: 7. Excessive involvement in activities that have a high potential for painful consequences (e.g., engaging in unrestrained buying sprees, sexual indiscretions, or foolish business investments). (Positive Urgency)</td>
</tr>
<tr>
<td></td>
<td>Gambling disorder</td>
<td>A. Persistent and recurrent problematic gambling behavior leading to clinically significant impairment or distress…: 5. Often gambles when feeling distressed (e.g., helpless, guilty, anxious, depressed). (Negative Urgency)</td>
</tr>
<tr>
<td></td>
<td>Borderline Personality Disorder</td>
<td>A. A pervasive pattern of instability of interpersonal relationships, self-image, and affects, and marked impulsivity…: 6. Affective instability due to a marked reactivity of mood (e.g., intense episodic dysphoria, irritability, or anxiety usually lasting a few hours and only rarely more than a few days). (Negative Urgency) 8. Inappropriate, intense anger or difficulty controlling anger (e.g., frequent displays of temper,</td>
</tr>
<tr>
<td>Three-factor model</td>
<td>DSM-5 disorder</td>
<td>Diagnostic criteria (DSM-5) (Specific Traits when agreement was reached between raters)</td>
</tr>
<tr>
<td>-------------------</td>
<td>----------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Lack of conscientiousness | Attention-Deficit/Hyperactivity Disorder | A. A persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development…:  
1. Inattention: …inconsistent with developmental level and that negatively impacts directly on social and academic/occupational activities:  
   b. Often has difficulty sustaining attention in tasks or play activities (e.g., has difficulty remaining focused during lectures, conversations, or lengthy reading). (Lack of Perseverance)  
   d. Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in work place (e.g., starts tasks but quickly loses focus and is easily sidetracked). (Lack of Perseverance)  
   f. Often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (e.g., schoolwork or homework; for older adolescents and adults, preparing reports, completing forms, reviewing length papers). (Lack of Perseverance) |
| Substance use disorders | | A. A problematic pattern of [substance] use leading to clinically significant impairment or distress…:  
1. [Substance] is often taken in larger amounts or over a longer period than was intended. (Lack of Premeditation)  
5. Recurrent [substance] use resulting in a failure to fulfill major role obligations at work, school, or home.  
6. Continued [substance] use despite having persistent or recurrent social or interpersonal problems caused or exacerbated by the effects of alcohol. (Lack of Premeditation)  
8. Recurrent [substance] use in situations in which it is physically hazardous. (Lack of Premeditation)  
9. [Substance] use is continued despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by alcohol |
<table>
<thead>
<tr>
<th>Three-factor model</th>
<th>DSM-5 disorder</th>
<th>Diagnostic criteria (DSM-5) (Specific Traits when agreement was reached between raters)</th>
</tr>
</thead>
</table>
|                    | Gambling disorder | B. Persistent and recurrent problematic gambling behavior leading to clinically significant impairment or distress…:  
|                    |                 | 6. After losing money gambling, often returns another day to get even (“chasing” one’s losses). (Lack of Premeditation)  
|                    |                 | 8. Has jeopardized or lost a significant relationship, job, or educational or career opportunity because of gambling. |
| Sensation seeking  | Gambling disorder | A. Persistent and recurrent problematic gambling behavior leading to clinically significant impairment or distress…:  
|                    |                 | 1. Needs to gamble with increasing amounts of money in order to achieve the desired excitement |
| Borderline Personality Disorder | | B. A pervasive pattern of instability of interpersonal relationships, self-image, and affects, and marked impulsivity…:  
|                                |                 | 4. Impulsivity in at least two areas that are potentially self-damaging (e.g., spending, sex, substance abuse, reckless driving, binge eating). |

Table 6. PID personality facets contributing primarily to PID-5 domain scores

<table>
<thead>
<tr>
<th>Domain</th>
<th>Facets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative Affect</td>
<td>Emotional Lability, Anxiousness, Separation Insecurity</td>
</tr>
<tr>
<td>Detachment</td>
<td>Withdrawal, Anhedonia, Intimacy Avoidance</td>
</tr>
<tr>
<td>Antagonism</td>
<td>Manipulativeness, Deceitfulness, Grandiosity</td>
</tr>
<tr>
<td>Disinhibition</td>
<td>Irresponsibility, Impulsivity, Distractibility</td>
</tr>
<tr>
<td>Psychoticism</td>
<td>Unusual Beliefs and Experiences, Eccentricity, Perceptual Dysregulation</td>
</tr>
</tbody>
</table>
### Table 7. Tests of Between-Subject Effects for Studies 1 and 2 on PID-5 Domains

<table>
<thead>
<tr>
<th>PID-5 Domain</th>
<th>Study 1</th>
<th></th>
<th>Study 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$F(3, 67)$</td>
<td>$\text{p}$</td>
<td>partial $\eta^2$</td>
<td>$F(3, 33)$</td>
</tr>
<tr>
<td>Negative Affect</td>
<td>11.30</td>
<td><strong>0.001</strong></td>
<td>0.144</td>
<td>11.61</td>
</tr>
<tr>
<td>Detachment</td>
<td>5.05</td>
<td><strong>0.028</strong></td>
<td>0.070</td>
<td>12.33</td>
</tr>
<tr>
<td>Antagonism</td>
<td>3.14</td>
<td>0.081</td>
<td>0.045</td>
<td>2.09</td>
</tr>
<tr>
<td>Disinhibition</td>
<td>16.27</td>
<td><strong>&lt;0.001</strong></td>
<td>0.195</td>
<td>28.80</td>
</tr>
<tr>
<td>Psychoticism</td>
<td>5.62</td>
<td><strong>0.021</strong></td>
<td>0.077</td>
<td>25.82</td>
</tr>
</tbody>
</table>

### Table 8. Group Comparisons for the PID-5 Personality Domains

<table>
<thead>
<tr>
<th>PID-5 Domain</th>
<th>Study 1 Gambling Disorder $n=33$</th>
<th>Control $n=38$</th>
<th>Study 2 Bipolar Disorder $n=18$</th>
<th>Control $n=19$</th>
<th>Cohen's $d$</th>
<th>Study 1</th>
<th>Study 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>95% CI</td>
<td>$M$</td>
<td>95% CI</td>
<td>$M$</td>
<td>95% CI</td>
<td>$M$</td>
</tr>
<tr>
<td>Negative Affect</td>
<td>1.05</td>
<td>[0.869, 1.239]</td>
<td>0.61</td>
<td>[0.443, 0.785]</td>
<td>0.35</td>
<td>[0.282, 0.412]</td>
<td>0.19</td>
</tr>
<tr>
<td>Detachment</td>
<td>0.91</td>
<td>[0.722, 1.095]</td>
<td>0.61</td>
<td>[0.439, 0.784]</td>
<td>0.27</td>
<td>[0.221, 0.328]</td>
<td>0.14</td>
</tr>
<tr>
<td>Antagonism</td>
<td>0.81</td>
<td>[0.632, 0.985]</td>
<td>0.59</td>
<td>[0.424, 0.751]</td>
<td>0.21</td>
<td>[0.157, 0.271]</td>
<td>0.16</td>
</tr>
<tr>
<td>Disinhibition</td>
<td>0.94</td>
<td>[0.785, 1.088]</td>
<td>0.50</td>
<td>[0.363, 0.644]</td>
<td>0.31</td>
<td>[0.257, 0.356]</td>
<td>0.12</td>
</tr>
<tr>
<td>Psychoticism</td>
<td>0.68</td>
<td>[0.502, 0.849]</td>
<td>0.39</td>
<td>[0.223, 0.545]</td>
<td>0.29</td>
<td>[0.229, 0.346]</td>
<td>0.08</td>
</tr>
</tbody>
</table>

**Note:** Values show the estimated marginal means and 95% confidence interval with covariates of sex and age = 43.49 (Study 1) and age = 37.78 (Study 2). Mean values for Study 2 represent log-transformed values. Effect sizes are represented as $GD$: Gambling Disorder and Control; $BD$: Bipolar Disorder and Control.
Table 9. PID-5 Domain with Discriminant Function (Structure Matrix) and Standardized Discriminant Function Coefficients

<table>
<thead>
<tr>
<th>PID-5 Domain</th>
<th>Study 1</th>
<th>Study 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Structure Matrix</td>
<td>Standardized Canonical Discriminant Function Coefficients</td>
</tr>
<tr>
<td>Negative Affect</td>
<td>0.72</td>
<td>0.30</td>
</tr>
<tr>
<td>Detachment</td>
<td>0.52</td>
<td>0.33</td>
</tr>
<tr>
<td>Antagonism</td>
<td>0.58</td>
<td>0.09</td>
</tr>
<tr>
<td>Disinhibition</td>
<td>0.92</td>
<td>0.79</td>
</tr>
<tr>
<td>Psychoticism</td>
<td>0.65</td>
<td>-0.25</td>
</tr>
</tbody>
</table>

Table 10. Correlations of PID-5 facets with discriminant function (structure matrix) and standardized discriminant function coefficients

<table>
<thead>
<tr>
<th></th>
<th>Study 1</th>
<th>Study 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Structure Matrix</td>
<td>Standardized Canonical Discriminant Function Coefficients</td>
</tr>
<tr>
<td>Disinhibition</td>
<td>0.585</td>
<td>0.162</td>
</tr>
<tr>
<td>Impulsivity</td>
<td><strong>0.990</strong></td>
<td><strong>0.919</strong></td>
</tr>
<tr>
<td>Irresponsibility</td>
<td>0.630</td>
<td>-0.008</td>
</tr>
</tbody>
</table>

**Negative Affect**
- Anxiousness | **0.948** | **0.695** | Eccentricity | 0.668 | 0.216 |
- Emotional Lability | 0.684 | 0.035 | Perceptual Dysregulation | **0.983** | **0.946** |
- Separation Insecurity | 0.821 | 0.387 | Unusual Beliefs & Experiences | 0.754 | -0.099 |

*Note: Bold-faced values show the facets that contributed most to the discrimination of groups in each domain.*
Table 11. Study 1: Stepwise Discriminant Function Analyses on all Facets of PID-5 Domains

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictor</th>
<th>Wilks $A$</th>
<th>$F(1, 69)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Impulsivity</td>
<td>0.87</td>
<td>24.81</td>
</tr>
<tr>
<td>2</td>
<td>Anhedonia</td>
<td>0.74</td>
<td>14.95</td>
</tr>
</tbody>
</table>

Table 12. Study 2: Stepwise Discriminant Function Analyses on all Facets of PID-5 Domains

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictor</th>
<th>Wilks $A$</th>
<th>$F(1, 35)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Distractibility</td>
<td>0.52</td>
<td>40.48</td>
</tr>
<tr>
<td>2</td>
<td>Perceptual Dysregulation</td>
<td>0.46</td>
<td>25.05</td>
</tr>
</tbody>
</table>

Table 13. Study 1 (GD Participants): Bivariate correlations (Pearson r) for Personality Traits, Depressive and Mania Symptoms and Gambling Severity

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PID-5 Negative Affect</td>
<td>1.05</td>
<td>0.58</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>PID-5 Detachment</td>
<td>0.92</td>
<td>0.50</td>
<td>0.011</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>PID-5 Antagonism</td>
<td>0.88</td>
<td>0.53</td>
<td>0.347*</td>
<td>-0.133</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>PID-5 Disinhibition</td>
<td>0.96</td>
<td>0.46</td>
<td>0.489**</td>
<td>0.120</td>
<td>0.604**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>PID-5 Psychoticism</td>
<td>0.72</td>
<td>0.59</td>
<td>0.518**</td>
<td>0.224</td>
<td>0.701**</td>
<td>0.712**</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>HAMD</td>
<td>3.67</td>
<td>5.07</td>
<td>0.078</td>
<td>-0.128</td>
<td>-0.254</td>
<td>-0.229</td>
<td>-0.580</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>YMRS</td>
<td>1.70</td>
<td>1.89</td>
<td>0.058</td>
<td>-0.022</td>
<td>-0.180</td>
<td>-0.071</td>
<td>-0.084</td>
<td>0.585**</td>
<td>1</td>
</tr>
<tr>
<td>8.</td>
<td>PGSI</td>
<td>9.38</td>
<td>6.49</td>
<td>0.173</td>
<td>0.183</td>
<td>0.091</td>
<td>0.232</td>
<td>0.262</td>
<td>-0.015</td>
<td>-0.038</td>
</tr>
</tbody>
</table>

*Correlation is significant at *$p < 0.05$. **Correlation is significant at $p < 0.01$. *
### Table 14. Study 1 (Control Participants): Bivariate correlations (Pearson r) for Personality Traits, Depressive, and Mania Symptoms and Gambling Severity

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PID-5 Negative Affect</td>
<td>0.62</td>
<td>0.45</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. PID-5 Detachment</td>
<td>0.60</td>
<td>0.53</td>
<td>0.474**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. PID-5 Antagonism</td>
<td>0.52</td>
<td>0.52</td>
<td>0.535**</td>
<td>0.307</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. PID-5 Disinhibition</td>
<td>0.48</td>
<td>0.43</td>
<td>0.699**</td>
<td>0.365*</td>
<td>0.690**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. PID-5 Psychoticism</td>
<td>0.35</td>
<td>0.39</td>
<td>0.704**</td>
<td>0.498**</td>
<td>0.725**</td>
<td>0.712**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. HAMD</td>
<td>1.13</td>
<td>1.55</td>
<td>0.190</td>
<td>0.328*</td>
<td>-0.179</td>
<td>0.076</td>
<td>0.086</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. YMRS</td>
<td>1.13</td>
<td>1.36</td>
<td>0.468**</td>
<td>0.417**</td>
<td>0.220</td>
<td>0.214</td>
<td>0.406*</td>
<td>0.532**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>8. PGSI</td>
<td>0.24</td>
<td>0.82</td>
<td>0.223</td>
<td>0.122</td>
<td>0.004</td>
<td>0.046</td>
<td>0.309</td>
<td>0.337*</td>
<td>0.432**</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: *Correlation is significant at *$p < 0.05$. **Correlation is significant at $p < 0.01$.

### Table 15. Study 2 (BD Participants): Bivariate correlations (Pearson r) for Personality Traits, Depressive, and Mania Symptoms and Gambling Severity

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PID-5 Negative Affect</td>
<td>0.35</td>
<td>0.16</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. PID-5 Detachment</td>
<td>0.28</td>
<td>0.13</td>
<td>0.543*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. PID-5 Antagonism</td>
<td>0.21</td>
<td>0.14</td>
<td>0.329</td>
<td>0.471*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. PID-5 Disinhibition</td>
<td>0.30</td>
<td>0.13</td>
<td>0.604**</td>
<td>0.638**</td>
<td>0.102</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. PID-5 Psychoticism</td>
<td>0.29</td>
<td>0.15</td>
<td>0.711**</td>
<td>0.581*</td>
<td>0.377</td>
<td>0.652**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. HAMD</td>
<td>9.13</td>
<td>7.40</td>
<td>0.579*</td>
<td>0.247</td>
<td>0.125</td>
<td>0.466</td>
<td>0.447</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. YMRS</td>
<td>3.40</td>
<td>2.66</td>
<td>0.255</td>
<td>0.505*</td>
<td>0.187</td>
<td>0.375</td>
<td>0.167</td>
<td>0.445</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>8. PGSI</td>
<td>1.39</td>
<td>3.38</td>
<td>-0.052</td>
<td>0.461</td>
<td>-0.030</td>
<td>0.503*</td>
<td>-0.035</td>
<td>0.196</td>
<td>0.306</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: *Correlation is significant at *$p < 0.05$. **Correlation is significant at $p < 0.01$. 
Table 16. Study 2 (Control Participants): Bivariate correlations (Pearson r) for Personality Traits, Depressive, and Mania Symptoms and Gambling Severity

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PID-5 Negative Affect</td>
<td>0.19</td>
<td>0.11</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. PID-5 Detachment</td>
<td>0.14</td>
<td>0.09</td>
<td></td>
<td>0.495*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. PID-5 Antagonism</td>
<td>0.16</td>
<td>0.10</td>
<td>0.328</td>
<td>0.447</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. PID-5 Disinhibition</td>
<td>0.12</td>
<td>0.06</td>
<td>0.471*</td>
<td>0.521*</td>
<td>0.684**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. PID-5 Psychoticism</td>
<td>0.08</td>
<td>0.07</td>
<td>0.328</td>
<td>0.071</td>
<td>0.546*</td>
<td>0.567*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. HAMD</td>
<td>0.67</td>
<td>1.41</td>
<td>-0.057</td>
<td>-0.213</td>
<td>-0.118</td>
<td>0.179</td>
<td>0.375</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. YMRS</td>
<td>0.89</td>
<td>1.23</td>
<td>-0.063</td>
<td>-0.063</td>
<td>-0.046</td>
<td>0.232</td>
<td>0.004</td>
<td>0.079</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>8. PGSI</td>
<td>0.11</td>
<td>0.32</td>
<td>0.104</td>
<td>0.032</td>
<td>0.087</td>
<td>0.056</td>
<td>0.273</td>
<td>-0.118</td>
<td>-0.180</td>
<td>1</td>
</tr>
</tbody>
</table>

*Note: * Correlation is significant at *p* < 0.05. **Correlation is significant at *p* < 0.01.
### Table 17. Demographics: Study 1 (GD Participants)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>%</th>
<th>Characteristic</th>
<th>M (years)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td>Male</td>
<td>23</td>
<td>69.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Female</td>
<td>10</td>
<td>30.3</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td>Canadian</td>
<td>29</td>
<td>87.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>East Asian</td>
<td>3</td>
<td>9.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Middle Eastern</td>
<td>1</td>
<td>3.0</td>
</tr>
</tbody>
</table>

### Table 18. Demographics: Study 1 (Control Participants)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>%</th>
<th>Characteristic</th>
<th>M (years)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td>Male</td>
<td>13</td>
<td>34.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Female</td>
<td>25</td>
<td>65.8</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td>Canadian</td>
<td>27</td>
<td>71.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>East Asian</td>
<td>4</td>
<td>10.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>European</td>
<td>2</td>
<td>5.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>American</td>
<td>1</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Caribbean</td>
<td>1</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>South American</td>
<td>1</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Middle Eastern</td>
<td>1</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>African</td>
<td>1</td>
<td>2.6</td>
</tr>
</tbody>
</table>
### Table 19. Demographics: Study 2 (BD Participants)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>%</th>
<th>Characteristic</th>
<th>M (years)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>5</td>
<td>27.8</td>
<td></td>
<td>37.0</td>
<td>11.74</td>
</tr>
<tr>
<td>Female</td>
<td>13</td>
<td>72.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canadian</td>
<td>17</td>
<td>94.4</td>
<td></td>
<td>15.5</td>
<td>2.45</td>
</tr>
<tr>
<td>South American</td>
<td>1</td>
<td>5.6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 20. Demographics: Study 2 (Control Participants)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>%</th>
<th>Characteristic</th>
<th>M (years)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>8</td>
<td>42.1</td>
<td></td>
<td>38.5</td>
<td>10.98</td>
</tr>
<tr>
<td>Female</td>
<td>11</td>
<td>57.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canadian</td>
<td>10</td>
<td>52.6</td>
<td></td>
<td>15.9</td>
<td>1.82</td>
</tr>
<tr>
<td>European</td>
<td>2</td>
<td>10.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle Eastern</td>
<td>2</td>
<td>10.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>American</td>
<td>1</td>
<td>5.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>East Asian</td>
<td>1</td>
<td>5.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central American</td>
<td>1</td>
<td>5.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South American</td>
<td>1</td>
<td>5.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Asian</td>
<td>1</td>
<td>5.3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 1. Graph shows mean-level differences across diagnostic and control groups for each PID-5 domain. Using Pillai’s trace, there was a significant group difference on GD and control participants, $V = 0.23$, $F(5, 63) = 3.85$, $p = .004$. Note: *$p < 0.05$, **$p < 0.01$, ***$p \leq 0.001$. GD participants scored on average, significantly higher than all of the control participants on all PID-5 domains. GD participants scored the highest on the Negative Affect ($M = 1.05$) domain followed by Disinhibition ($M = 0.96$), Detachment ($M = 0.92$), Antagonism ($M = 0.88$), and Psychoticism ($M = 0.72$). Control participants scored the highest on the Negative Affect ($M = 0.62$) domain followed by Detachment ($M = 0.60$), Antagonism ($M = 0.52$), Disinhibition ($M = 0.48$), and Psychoticism ($M = 0.35$).
Figure 2. Graph shows mean-level differences across diagnostic and control groups for each PID-5 domain (data has been log transformed). Using Pillai’s trace, there was a significant group difference on BD and control participants, $V = 0.52, F(5, 29) = 6.15, p = .001$. Note: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. BD participants scored on average, significantly higher than all of the control participants on all PID-5 domains. BD participants scored the highest on the Negative Affect ($M = 0.35$) domain followed by Disinhibition ($M = 0.31$), Psychoticism ($M = 0.29$), Detachment ($M = 0.28$), and Antagonism ($M = 0.21$). Control participants scored the highest on the Negative Affect ($M = 0.19$) domain followed by Antagonism ($M = 0.16$), Detachment ($M = 0.14$), Disinhibition ($M = 0.12$), and Psychoticism ($M = 0.08$).