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An Examination of the HEXACO Model of Personality in Alcohol Use Disorder, Cannabis Use  
Disorder, and Gambling Disorder

by

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## **Abstract**

Research within the field of addictive behaviours has found that personality traits as measured by the Five Factor Model (FFM) of personality are predictive of engaging in substance use and gambling at problematic levels. However, the structure of the FFM has been criticized as being incomplete, with recent lexical studies identifying a sixth personality dimension. The aim of the present study was to examine this six-factor (HEXACO) model of personality in relation to disordered engagement in three addictive behaviours: alcohol (AUDs), cannabis (CUDs), and gambling (GDs). Four groups of participants (AUDs, CUDs, GDs, and healthy controls;  $N = 308$ ) completed the 100-item HEXACO Personality Inventory-Revised. Scores on the six subscales (honesty-humility, emotionality, extraversion, agreeableness, conscientiousness, and openness to experience) were compared across groups. Multinomial logistic regression analyses revealed lower levels of honesty-humility among AUDs and GDs and higher levels of openness among CUDs relative to control participants. AUDs and GDs also reported lower levels of honesty-humility when compared to CUDs. Results support the utility of the HEXACO model in the field of addictive behaviours and highlight the potential role of honesty-humility in the development and maintenance of substance use disorders and behavioural addictions.

*Keywords:* addiction, personality, HEXACO, alcohol, cannabis, gambling

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## **List of Abbreviations**

AUD	Alcohol use disorder
AUDIT	Alcohol Use Disorder Identification Test
AUDIT-C	Alcohol Use Disorder Identification Test-Consumption
CAST	Cannabis Abuse Screening Test
CUD	Cannabis use disorder
DASS	Depression Anxiety Stress Scales
DAST	Drug Abuse Screening Test
FFM	Five Factor Model
GD	Gambling disorder
HC	Healthy control
HEXACO-PI-R	HEXACO Personality Inventory-Revised
MTurk	Mechanical Turk
PGSI	Problem Gambling Severity Index
SUD	Substance use disorder

## **Introduction**

Research indicates that certain dispositional factors may increase the likelihood that one engages in various addictive behaviours, both recreationally as well as at problematic levels (Dick et al., 2013). Personality as measured by the Five Factor Model (FFM; Costa & McCrae, 1992) has been examined in relation to a range of clinical disorders, including alcohol use disorder (AUD), substance use disorders (SUDs; Grekin, Sher, & Wood, 2006), and gambling disorder (GD; Bagby et al., 1999). Results of such studies suggest that traits differ across addictions, which may have implications for both research and practice (Terracciano, Löckenhoff, Crum, Bienvenu, & Costa, 2008).

Despite widespread adoption of the FFM in the addictions literature, other research using a similar lexical methodology has identified an alternative structure of personality (e.g., Ashton et al., 2004). Some aspects of personality are argued to be underrepresented in the FFM (Ashton, Lee, & de Vries, 2014). Lee and Ashton's (2004) HEXACO model addresses some of the limitations of the FFM and could provide a novel way of examining the influence of personality characteristics on addictive behaviours. The proposed study aims to investigate the association between the six factors of the HEXACO model of personality among individuals reporting problematic levels of alcohol use, cannabis use, and gambling. Specifically, the proposed study aims to examine the extent to which the three groups differ from one another and from healthy controls across individual HEXACO dimensions.

### **Personality**

Personality is generally defined as an individual's pattern of thinking about, relating to, and interacting with the world (American Psychological Association, 2017). A plethora of research studies have examined the role of personality traits in predicting behaviour; that is, it is

assumed that who we are is to some extent reflected in how we behave. Though situational factors tend to exert a varying degree of influence over behaviour (Sherman, Nave, & Funder, 2010), personality traits have been found to be predictive of numerous adaptive and maladaptive behaviours (e.g., Giluk & Postlethwaite, 2015; Terrier, Kim, & Fernandez, 2016).

### **The Structure of Personality**

There is, as of yet, no consensus on how to ‘best’ conceptualize personality, and existing research within personality psychology has proposed many different models of personality structure varying from a single higher-order factor to sixteen unique dimensions (e.g., Cattell, 1946; Muek, 2007). Yet, the FFM (Costa & McCrae, 1992) has been among the most widely studied. The roots of FFM can be traced back to lexical studies of personality structure. The ‘lexical hypothesis’ (Galton, 1884; Goldberg, 1982, 1993) posits that the most predominant personality characteristics will eventually become part of our language; thus, studies using the lexical approach to understand personality structure do so by factor-analyzing ratings on personality adjectives of a language. Based on past lexical research findings (Cattell, 1947; Digman & Takemoto-Chock, 1981; Goldberg, 1983), Costa and McCrae (1985, 1992) fashioned the NEO-Personality Inventory (NEO-PI, NEO-PI-R), a 240-item measure assessing five major dimensions of personality.

Within the FFM framework (Costa & McCrae, 1992), *neuroticism* describes an individual’s tendency to experience negative emotions, such as anger, anxiety, and depression; *extraversion* refers to one’s level of sociability and the tendency to experience positive emotions; *conscientiousness* includes the extent to which one is organized, disciplined, and achievement-oriented; *agreeableness* describes the way in which one tends to relate to others and encompasses one’s level of cooperativeness, compassion, and trust in others; and *openness to*

*experience* includes one's level of appreciation for novel experiences and ideas. Each of these five domains can be further divided into six facets, each of which captures a unique dimension of the personality trait that it falls under. Neuroticism includes facets of anxiety, angry hostility, depression, self-consciousness, impulsiveness, and vulnerability (i.e., to stress). Extraversion consists of warmth, gregariousness, assertiveness, activity, excitement seeking, and positive emotions. Openness to experience distinguishes between fantasy, aesthetics, feelings, actions, ideas, and values. Dimensions of agreeableness include trust, straightforwardness, altruism, compliance, modesty, and tender-mindedness. Finally, conscientiousness is separated into elements of competence, order, dutifulness, achievement striving, self-discipline, and deliberation.

The FFM has been validated in research with clinical (Bagby et al., 1999; Rector, Bagby, Huta, & Ayearst, 2012) and community samples (Bienvenu et al., 2004) and has been studied cross-culturally (Ispas, Iliescu, Ilie, & Johnson, 2014; McCrae, Costa, Del Pilar, Rolland, & Parker, 1998). Research using the FFM has examined behaviours as diverse as prosocial behaviour (Habashi, Graziano, & Hoover, 2016), religious participation (Furnham & Cheng, 2015), parenting behaviour (Prinzle, Stams, Dekovic, Reijntjes, & Belsky, 2009), procrastination (Watson, 2001), and criminality (Becerra-Garcia, Garcia-Leon, Muela-Martinez, & Egan, 2013) to name a few. The predictive value of the FFM has been demonstrated in longitudinal research, with results indicating that certain traits in adolescence or young adulthood are predictive of counterproductive work behaviour, symptoms of internalizing psychological disorders, risky sexual behaviour, antisocial behaviour, and substance use (Le, Donnellan, Spilman, Garcia, & Conger, 2014; Mezquita et al., 2015; Miller et al., 2004; Mõttus, Guljajec, Allik, Laidra, & Pullman, 2011; Soldz & Vaillant, 1999).

## **The Five Factor Model and Addictive Behaviours**

Research examining associations between personality traits and addictive behaviours has typically framed this relationship as one in which certain traits serve as predisposing factors for addictive behaviours (e.g., Wallace, Ullsperger, & Nikolas, 2016). In other words, certain personality traits or profiles may represent independent risk factors for addiction. Meta-analyses examining the FFM in relation to alcohol and substance use have identified neuroticism, conscientiousness, and agreeableness as the personality dimensions most strongly related to these addictive behaviours (Malouff, Thorsteinsson, Rooke, & Schutte, 2007; Malouff, Thorsteinsson, & Schutte, 2006). Such findings suggest a personality profile in which one may have a tendency to act on negative emotions, to have difficulty controlling one's behaviour, and to be suspicious and antagonistic of others.

With regard to extraversion and openness, results have been inconsistent. For instance, extraversion has been found to be associated with the use of various substances in some studies (Livingston, Oost, Heck, & Cochran, 2015; Mercado et al., 2016; Ribadier, Dorard, & Varesco, 2016), no association between this trait and substance use has been found in others (Malouff et al., 2007; Quirk & McCormick, 1998; Terracciano & Costa, 2004). With regard to the trait of openness to experience, studies have found a positive relationship between this trait and involvement in addictive behaviours primarily among young people (Malouff et al., 2007). Coupled with meta-analytic findings indicating a non-significant relationship between openness and symptoms of AUD or SUDs (Kotov, Gamez, Schmidt, & Watson, 2010), some researchers have speculated that this association may be limited to the likelihood of experimenting with substances, but not with the disordered use of them (Malouff et al., 2007). Another set of research findings examining personality and substance use suggests that openness may be

specific to the use of certain substances, particularly cannabis (Flory, Lynam, Milich, Leukefeld, & Clayton, 2002; Fridberg, Vollmer, O'Donnell, & Skosnik, 2011; Mercado et al., 2016; Terracciano et al., 2008).

Despite the above-mentioned similarities in personality characteristics among individuals presenting with problematic use of substances or addictive behaviours, personality profiles appear to differ in relation to the type of substance or behaviour (e.g., Mercado et al., 2016). Traits associated with alcohol use, for instance, may differ from those associated with the use of other substances (McGue, Slutske, & Iacono, 1999), or from non-substance-related addictive behaviours such as gambling. The role of the FFM in alcohol, substance use, and gambling are discussed next in turn.

### **The Five Factor Model and Alcohol Use Disorders**

Ruiz, Pincus, and Dickinson (2003) examined the relation between drinking patterns and the FFM in college students at both the higher-order (factor) and lower-order (facet) levels. At the factor level, quantity and frequency of alcohol consumption was found to be associated to neuroticism and conscientiousness. At a lower level, those reporting greater alcohol consumption reported higher self-consciousness, impulsiveness, and vulnerability (facets of neuroticism) and lower levels of competence, order, dutifulness, achievement-striving, and deliberation (facets of conscientiousness). Despite no factor-level differences for extraversion and agreeableness, higher levels of alcohol consumption were associated with higher levels of gregariousness and excitement-seeking (facets of extraversion) and lower levels of straightforwardness and tender-mindedness (facets of agreeableness). While the authors argued that the inconsistencies between factor- and facet-level findings with regard to drinking were too small in magnitude to be considered meaningful, the pattern of facet-level differences suggests that some personality

aspects such as lower levels of sincerity (as measured by the straightforwardness facet) and lower levels of concern for others (as measured by the tendermindedness facet) may be important to consider with regard to alcohol use. Moreover, given the role of alcohol in social gatherings, individuals reporting higher levels of alcohol consumption may be higher in certain aspects of extraversion (Flory et al., 2002).

It is possible that factor-level differences measured by the FFM are more easily identified when examining group differences in alcohol consumption. For instance, longitudinal research has found that moderate drinkers reported higher levels of openness than did individuals who abstained from alcohol use between adolescence and adulthood. Among drinkers, trajectories characterized by heavy alcohol consumption were associated with the highest levels of openness and the lowest levels of agreeableness than light drinking or moderate drinking patterns (Chassin, Flora, & King, 2004). While Chassin and colleagues did not examine extraversion in this particular study, other research suggests that extraversion is an important personality variable to consider with regard to alcohol consumption. A meta-analysis which included over 70,000 participants found that the transition over time from moderate to heavy alcohol use was more common among those with higher extraversion and openness scores, whereas those who transitioned from moderate alcohol use to abstinence reported lower levels of extraversion and conscientiousness, and higher levels of agreeableness (Hakulinen et al., 2015).

In addition to the association between personality and patterns of alcohol consumption, personality traits are also differentially associated with the development of AUD, as well as its severity and one's risk of relapse following treatment. Martin and Sher (1994) found that individuals with a family history of AUD (i.e., high-risk) scored significantly higher on FFM openness and significantly lower on agreeableness and conscientiousness than those with no

family history (i.e., low-risk). Furthermore, those participants who received a later AUD diagnosis reported lower levels of conscientiousness and agreeableness, and higher levels of neuroticism, as compared to those individuals who did not develop AUD.

Though Martin and Sher's (1994) sample consisted of community participants, research conducted with clinical samples has obtained similar results. Moreover, studies using clinical samples have tended to find a stronger relationship between traits of neuroticism and conscientiousness and alcohol involvement than studies using non-treatment-seeking samples (Malouff et al., 2007). Greater AUD severity has been found to be associated with higher levels of neuroticism and lower levels of conscientiousness in both cross-sectional (Schwandt, Heilig, Hommer, George, & Ramchandani, 2013) and longitudinal research (Jacob, Koenig, Howell, Wood, & Haber, 2009). These traits have also been identified as increasing one's risk of relapse following treatment for AUD (Bottlender & Soyka, 2005), with neuroticism in particular predicting a shorter time to relapse (Finn & Robinson, 2012).

Hopwood and colleagues (2007) examined differences among individuals who had never received an AUD diagnosis, those with a remitted AUD diagnosis, and individuals who currently met AUD criteria at both the factor and facet level of the FFM. Compared to never-diagnosed individuals, those with a lifetime diagnosis of AUD (i.e., remitted or currently-diagnosed) reported lower scores on agreeableness and conscientiousness. Within these factors, the two AUD groups both differed from never-diagnosed individuals on levels of trust, compliance, competence, dutifulness, achievement-striving, and deliberation. The groups also differed on neuroticism facets of angry hostility and impulsiveness. In addition to the above-mentioned differences, a comparison of currently-diagnosed participants to those who had never received an AUD diagnosis also revealed significant differences in the straightforwardness facet of

agreeableness. Remitted individuals scored significantly higher on levels of neuroticism overall, and significantly lower on extraversion facets of warmth and gregariousness, than never-diagnosed participants. Only the extraversion facet of excitement-seeking differentiated the three groups from one another.

Such results suggest that significant relationships between AUD and certain aspects of personality may not always be detected if such aspects are examined alongside other, less-relevant components. For instance, it is possible that differences between never- and currently-diagnosed individuals on levels of impulsiveness and angry hostility were, in a sense, ‘washed out’ by the lack of significant association between the two on the remaining neuroticism facets. Research examining the structure of the FFM has found significant cross-loadings of angry hostility with facets of agreeableness (Piedmont & Ciarrochi, 1999), and impulsiveness was shown to have its strongest loading on a factor characterized by conscientiousness (Ashton, Lee, de Vries, Hendrickse, & Born, 2012). These two facets are strongly associated with externalizing behaviour, including both the stability of conduct problems over time as well as the variety of delinquent acts that an individual reports engaging in (Miller, Lynam, & Leukefeld, 2003).

In summary, the research on the FFM in relation to AUD indicates that meaningful differences in neuroticism, conscientiousness, and agreeableness may exist between those who receive an AUD diagnosis and those who do not. Within these traits, AUD-diagnosed individuals also differ from controls on many, but not all, facets. While higher levels of openness and extraversion may be associated with an increased likelihood of consuming alcohol and heavier alcohol consumption, these traits do not appear to be associated with alcohol consumption at problematic levels.

### **The Five Factor Model and Substance Use Disorders**

The few studies that have examined the FFM in relation to licit and illicit drug use have identified differences not only in users as compared to non-users of various substances, but also between current and former users, and between users of different substances. In Mercado and colleagues' (2016) examination of the FFM and tobacco, cannabis, and cocaine use, the use of all three substances was associated with higher extraversion and lower agreeableness and conscientiousness scores. However, higher levels of neuroticism uniquely predicted cocaine use, and higher levels of openness uniquely predicted cannabis use.

Terracciano and colleagues (2008) compared never-, former, and current users of tobacco, cannabis, and cocaine/heroin at the trait level as well as the facet level. For all three substances, overall conscientiousness levels as well as the same five facets within the conscientiousness domain (competence, dutifulness, achievement-striving, self-discipline, and deliberation) were lower for current as compared to never-users. Differences in overall neuroticism levels were identified for tobacco and cocaine/heroin users, with former tobacco users more closely resembling current users and former cocaine/heroin users more closely resembling never-users. At the facet level for both substances, never-users scored significantly lower than did current users on all of the six facets. Despite finding no significant overall differences in neuroticism for cannabis use, never-users scored significantly lower than current users on facets of angry hostility and vulnerability. Similarly, overall differences in agreeableness were identified only for cannabis use, but current users of all three substances scored significantly lower than did never-users on the compliance facet. Indeed, despite the lack of differences in agreeableness in relation to cocaine/heroin use, the profile within agreeableness appeared to differentiate these individuals from tobacco or cannabis users. While cannabis and

tobacco users reported relatively low scores on altruism, cocaine/heroin users reported low scores on facets of trust and straightforwardness.

In addition to these differences, Terracciano and colleagues (2008) identified a unique personality profile among cannabis users in levels of openness to experience. Not only were overall differences in openness levels identified only in relation to cannabis use, never-users scored lower than did former- and current users on the values facet, suggesting that the decision to use cannabis in the first place may be influenced by one's willingness to challenge traditional values. Though one can only speculate, it is possible that this particular association may be weakened with increasing acceptance of cannabis use within society (Berg et al., 2015). With regard to differences between former and current cannabis users, former users reported lower scores on facets of aesthetics, actions, and ideas than did current users. Given that many cannabis users report enhanced feelings of creativity under the influence (Green, Kavanagh, & Young, 2003), users whose personality traits align with certain subjective effects of cannabis may be more likely to continue using it.

The association between openness and cannabis use is longstanding and rather robust: Victor, Grossman, and Eisenman's (1973) examination of personality and cannabis use in adolescents found that users reported heightened levels of creativity, adventuresomeness, and novelty-seeking. Indeed, individuals who report using cannabis for 'expansion' reasons, such as to understand things differently, to know themselves better, to be more creative, or to be more open to new experiences, tend to report more frequent use of cannabis, and these motives are predictive of symptoms of CUD (Chabrol, Ducongé, Casas, Roura, & Carey, 2005; Simons, Correia, Carey, & Borsari, 1998). Moreover, higher levels of openness are associated with symptoms of disordered cannabis use, but not with symptoms of other SUDs such as AUD

(Flory et al., 2002; Fridberg et al., 2011). Perhaps in part because of the recent – though increasing – legalization of recreational cannabis in many American jurisdictions (Siegel, 2017), and an upcoming change in its legal status within Canada (Cox, 2018), as of yet, research examining cannabis users is lacking compared to licit substances such as alcohol or tobacco. For instance, though research has examined cannabis use and the FFM at the facet level (Terracciano et al., 2008), it is not yet clear whether these same facets may be associated with symptoms of disordered cannabis use.

In sum, the small body of research aiming to identify differences in FFM traits between substance users and non-users suggests that substance use in general may be more likely among those who report lower levels of conscientiousness. Similarly, levels of angry hostility as measured by FFM neuroticism may not differ in relation to substance of choice. However, the personality profile of cannabis users indicated by the available research suggests that these individuals may significantly differ from users of other licit and illicit substances particularly with regard to neuroticism and many of its facets, as well as agreeableness. Finally, cannabis use appears to be uniquely related to the trait of openness to experience.

### **The Five Factor Model and Behavioural Addictions**

There has also been a paucity of research studies examining the association between FFM personality dimensions and behavioural addictions. Yet, among the limited research findings that do exist, it appears that different behavioural addictions are associated with a unique constellation of traits (Andreassen et al., 2013). In particular, GD has often been studied alongside SUDs (e.g., Rennert et al., 2014) and AUD (e.g., Bodor, Tomic, Ricijas, Zoricic, & Filipic, 2016) and is highly comorbid with both (Lorains, Cowlshaw, & Thomas, 2011). Moreover, when GD is examined alongside other behavioural addictions as well as SUDs,

findings suggest that the personality profile of GDs is more similar to those with SUDs (Walther, Morgenstern, & Hanewinkel, 2012).

Little research has examined gambling behaviour independent of gambling-related problems. In a sample of adolescents, low-risk gamblers reported lower levels of agreeableness and openness to experience than did non-gamblers, and high-risk gamblers reported lower levels of agreeableness than low-risk gamblers (Hanss et al., 2015). Similar results were obtained in a sample of university students, with findings indicating that lower levels of openness to experience and agreeableness are predictive of higher scores on measures of gambling-related problems (Buckle, Dwyer, Duffy, Brown, & Pickett, 2013). The association between gambling and openness to experience is particularly intriguing – while higher levels have been suggested to potentially influence one’s decision to engage in certain addictive behaviours (e.g., alcohol use; Malouff et al., 2007), research which has found an association between openness and gambling involvement indicating that this relationship is negative. That is, gamblers report *lower* levels of openness than do non-gamblers. It is possible that lower levels of openness may be reflected in lower levels of cognitive flexibility (McCrae & Costa, 1987), which may influence some individuals who endorse certain cognitive biases to gamble. However, the relationship between openness to experience and gambling also appears to be inconsistent: other research has found that certain facets of neuroticism (impulsiveness), agreeableness (straightforwardness), and conscientiousness (dutifulness and self-discipline) are most predictive of gambling-related problems, with no association found for openness or its facets (MacLaren, Best, Dixon, & Harrigan, 2011). This inconsistency has been identified in research comparing GDs to non-GDs, with few studies finding significantly lower openness scores in GDs (Myrseth, Pallesen, Molde, Johnsen, & Lorvik, 2009).

Research examining FFM traits in GDs and non-GDs has typically identified neuroticism as a strong correlate (Miller et al., 2013), with many studies finding differences in levels of conscientiousness as well (Bagby et al., 2007; Brunborg, Hanss, Mentzoni, Molde, & Pallesen, 2016). GDs also report significantly higher levels of neuroticism and significantly lower levels of conscientiousness than do non-gamblers (Kaare, Mõttus, & Konstabel, 2009). Among GDs, those reporting greater symptom severity tend to report lower levels of agreeableness (Brunborg et al., 2016). Findings from longitudinal research examining GD and the FFM, as well as a small number of its facets, indicate that lower agreeableness and conscientiousness, as well as higher scores on neuroticism facets of vulnerability and impulsivity, are predictive of continued GD over a period of five years; such traits may make GDs more susceptible to relapse (Williams et al., 2015).

Indeed, certain traits appear to play a role in successful treatment outcomes for treatment-seeking GDs. Specifically, individuals reporting lower levels of agreeableness and conscientiousness have been found to be less likely to complete treatment, and low levels of conscientiousness have been found to predict relapse following treatment (Ramos-Grille, Gomà-i-Freixanet, Aragay, Valero, & Vallès, 2013).

To summarize, agreeableness, neuroticism, and conscientiousness appear to most strongly differentiate GDs from non-GDs or non-gamblers. While findings indicating a relationship between GD and openness to experience have been less consistently found, those which have identified an association indicate that GD risk may be increased among those reporting lower levels of this trait.

### **Personality Comparisons Among Addictive Behaviours**

The studies mentioned above assessed personality differences among users of various substances. However, little research has directly compared the personalities of individuals based on their preferred substance. Valila's (2008) doctoral dissertation examined FFM traits and facets in relation to substance of choice among treatment-seeking participants. Results indicated significant differences between all substance use groups, with those reporting problematic use of depressants (including alcohol) scoring highest on overall levels of neuroticism relative to other substances, including cannabis. With regard to extraversion, conscientiousness, and agreeableness, cannabis users reported higher levels than did depressant users. Supporting the notion that openness is strongly related to cannabis use, cannabis users reported the highest overall levels of openness to experience relative to all other substance categories. Conversely, depressant users reported the lowest levels of openness.

Though Valila (2008) did not provide information on the specific depressant participants were seeking treatment for, recent research comparing personality traits of treatment-seeking participants with AUD to those with opiate use disorders have found that individuals with AUD report higher levels of agreeableness and conscientiousness and lower levels of neuroticism. While facet-level differences varied between studies, both found higher scores among AUD participants on the agreeableness facet of trust (Gupta, Ambekar, Dhawan, & Mehta, 2017; Raketich et al., 2017).

Gupta and colleagues (2017) and Raketich and colleagues (2017) compared the personality profiles of 'pure' AUD and SUD groups; that is, individuals who met criteria for only one disorder or the other. However, those meeting criteria for AUD have an increased likelihood of also meeting criteria for SUDs (Grant et al., 2015). Relative to those meeting criteria for more than one SUD (i.e., polysubstance users), individuals with AUD report higher levels of

agreeableness and conscientiousness and lower levels of openness. At the facet level, individuals with AUD score lower on the excitement-seeking facet within extraversion and higher on particular facets within openness (actions), agreeableness (straightforwardness), and conscientiousness (order, dutifulness, achievement-striving, and self-discipline) than do polysubstance users (Lackner, Unterrainer, & Neubauer, 2013). Other research has found differences between individuals meeting diagnostic criteria for a single substance (i.e., alcohol or cocaine) and those who meet criteria for two or three SUDs. For instance, though lower levels of agreeableness and conscientiousness were found among polysubstance users than those reporting problems with only alcohol or only cocaine, those with cocaine-only SUDs reported higher levels of extraversion and openness and lower levels of neuroticism than did those with AUD (McCormick, Dowd, Quirk, & Zegarra, 1998). Given that both of the above-mentioned studies found that polysubstance users differed significantly from those with single addictive behaviours on two traits seemingly common to those who struggle with addictions (i.e., low agreeableness, low conscientiousness), the antagonistic and impulsive profile of polysubstance users may partially reflect a more pronounced profile of those with SUDs in general.

A recent study conducted in Israel compared treatment-seeking individuals with AUD, SUDs, GD, and compulsive sexual behavior (CSB) to a group of healthy controls and to each other on FFM traits (Zilberman, Yadid, Efrati, Neumark, & Rassoovsky, 2018). Relative to controls, all four groups scored significantly higher on FFM neuroticism and on a measure of impulsivity, while unique differences were found between AUDs and HCs on extraversion, agreeableness, openness, and conscientiousness and between SUDs and CSBs on FFM agreeableness and conscientiousness. When compared to one another, AUDs reported significantly lower levels of extraversion relative to SUDs and GDs and lower levels of openness

relative to CSBs. Conversely, GDs reported lower levels of neuroticism and conscientiousness relative to CSBs and higher levels of agreeableness relative to SUDs and CSBs. The authors concluded that the personality profile of GDs was quite similar to that exhibited by HCs and thus GDs may be more influenced by environmental factors than dispositional factors. The significantly low levels of conscientiousness observed among SUDs was suggested to be a reflection of low conscientiousness individuals' willingness to violate social rules, given the illegal status of many substances.

While Zilberman and colleagues (2018) compared FFM traits across four addictive behaviours and provided evidence for distinct personality profiles based on substance or behavior of choice, results may have been confounded by other variables. Analyses were conducted with no covariates, despite research indicating normative changes in personality traits across the lifespan (Roberts, Walton, & Viechtbauer, 2006) and gender differences in FFM traits (Weisberg, DeYoung, & Hirsh, 2011). This is particularly important with regard to the authors' conclusions regarding GDs – the older age of GD onset relative to the other addictive behaviours was argued to support the suggestion that GD may be more influenced by environmental factors than personality. However, it is unclear different results may have been obtained if the authors had controlled for participant age or gender. In addition, SUDs were not homogeneous in terms of substance of choice – though the study provided information on lifetime use of various substances, the authors did not appear to restrict participation to particular substances.

Results from the few studies which have examined the association between personality traits and the use of various substances suggest that there are indeed differences in personality traits in relation to substance type. However, this research has tended to compare personality traits between users of licit (e.g., alcohol and tobacco) and illicit substances (e.g., cocaine,

opiates) (Gupta et al., 2017; Koller, Preuss, Lü, Soyka, & Pogarell, 2015; Lackner et al., 2013; Quirk & McCormick, 1998; Raketich et al., 2017), and the ability to draw conclusions from studies comparing individuals with a single addictive disorder to those meeting criteria for multiple addictive disorders may be limited. Moreover, the samples utilized in many existing studies have been relatively small and have consisted almost exclusively of treatment-seeking participants (Koller et al., 2015; Lackner et al., 2013; Raketich et al., 2017; Zilberman et al., 2018). Given that very few individuals meeting criteria for AUD or SUDs actually seek treatment (Teesson, Baillie, Lynskey, Manor, & Degenhardt, 2006), as well as meta-analytic findings indicating that the association between FFM traits and AUD or SUDs is stronger in treatment-seeking samples (Kotov et al., 2010; Malouff et al., 2007), results from such studies may not be representative of individuals struggling with addictions. Finally, as no existing research has examined potential differences in personality traits associated with addictive behaviours such as gambling to those associated with alcohol or substance use, the extent to which personality traits of individuals with GD differ from those with AUD or SUDs is unclear.

Another issue that may also affect how results may be interpreted is that of comorbidity. Polysubstance use and comorbid addictive behaviour disorders have been handled in a number of ways in previous studies, all with their own strengths and limitations. Flory and colleagues (2002) statistically controlled for participants' comorbid AUD and CUD symptoms in analyses to determine unique relationships between these disorders and FFM traits. Controlling for comorbidity in analyses is not necessarily a perfect solution to this issue and can introduce substantial levels of bias into analyses (Lash et al., 2007). In addition, the temporal relationship between comorbid addictive disorders may play a role. It is possible that individuals who first

use and experience problems with alcohol consumption may appreciably differ in personality from individuals who use and experience problems with cannabis prior to alcohol.

Other studies addressed comorbidity during the recruitment process. Participants with comorbid addictions in Zilberman and colleagues' (2018) study, for instance, were asked to report on their 'primary' addiction. This likely facilitates recruitment of a larger sample size, however, it is unclear whether personality profiles may have differed depending on comorbidity type and/or severity. In contrast, Gupta and colleagues (2017) included only 'pure' groups in their study – that is, individuals with only a single addictive disorder were permitted to participate. Though this method of handling the issue of morbidity may limit the generalizability of findings and reduced the number of eligible participants, it arguably ensures a greater degree of homogeneity between groups.

### **Personality Comparisons Among Addictive Behaviours**

Despite a large body of research in support of the FFM, both its structure as well as its content have been criticized. While the FFM has been translated for use with speakers of other languages (e.g., Bahta & Laher, 2013; Ispas et al., 2014; Kallmen, Wennberg, & Bergman, 2011), its origins lie in findings from lexical research conducted in English only (Ashton & Lee, 2007). A recent re-examination of archival data from the English language (Ashton, Lee, & Goldberg, 2004), as well as a series of recent studies in seven other languages (Ashton et al., 2004), have actually revealed a consistent six-factor structure. Importantly, this six-factor structure includes a dimension consisting of descriptors relating to sincerity, honesty, fairness, and modesty (Ashton & Lee, 2008).

While some of the above-mentioned descriptors are represented in the FFM to some degree (e.g., the straightforwardness and modesty facets of agreeableness as assessed by the

NEO-PI-R), some argue that aspects related to the tendency to deceive and exploit others are underrepresented in the FFM framework (Miller & Lynam, 2013). Such elements of personality may be theoretically relevant to the study of addictive behaviours. Though engaging in deceitful behaviour to conceal or maintain an addiction is absent from SUD and AUD criteria within the DSM-5, diagnostic criteria for GD has traditionally included lying to others in order to hide one's level of gambling involvement (American Psychiatric Association [APA], 2013). In addition, higher levels of GD severity have been found to correspond with higher levels of grandiose and manipulative aspects of psychopathy in young adult gamblers (Ručević, 2016). Further, research suggests an association between alcohol use and the tendency to manipulate others (Pugovkina & Popinako, 2014; Ruiz et al., 2003). Finally, differences in the extent of one's tendency to deceive or manipulate others have been found in relation to one's drug of choice, with levels of deceitfulness increasing between the time of SUD onset and treatment (Mayer, 2012).

Differences between never- and current users of various substances (e.g., Terracciano et al., 2008) and between those who have and have not received a lifetime AUD diagnosis (Hopwood et al., 2007) on certain facets of agreeableness, coupled with the relative consistency of research identifying an association between angry hostility and a variety of addictive behaviours (e.g., Hopwood et al., 2007; Kaare et al., 2009; Kornør & Nordvik, 2007; Lackner et al., 2013; Raketich et al., 2017; Terracciano et al., 2008), suggests that dispositional irritability may need to be examined in more detail. In addition, while a tendency to be irritable may be associated with some addictive behaviours, this may not be accompanied by a tendency to be highly anxious (Khazaal et al., 2013; Unsel et al., 2012).

### **The HEXACO Model of Personality**

Derived from a series of lexical studies in a number of languages, Lee and Ashton's (2004) HEXACO model of personality identified six nearly orthogonal personality factors, each containing four facets: honesty-humility, emotionality, extraversion, agreeableness, conscientiousness, and openness to experience. While extraversion, conscientiousness, and openness to experience in this model do not vastly differ from their FFM counterparts, HEXACO departs substantially from the FFM with regard to the conceptualization of descriptors originally captured by agreeableness and neuroticism. Within the HEXACO framework, emotionality describes the extent to which one is sentimental or emotionally sensitive. Measures of emotionality include levels of fearfulness (fear of harm or injury), anxiety (preoccupation with minor issues), dependence (need for emotional support), and sentimentality (emotional attachments to others). In contrast to FFM neuroticism, this dimension does not include the tendency to be temperamental or irritable. Lee and Ashton argue that such traits are better captured by the agreeableness factor within the HEXACO model, which describes the extent to which an individual is tolerant, patient, and lenient. Facets within this conceptualization of agreeableness include forgiveness (the tendency to hold grudges), gentleness (lenience in interactions with others), flexibility (level of cooperativeness with others), and patience (threshold for becoming angry or expressing anger).

In addition to these differences, the HEXACO model of personality includes a sixth factor, honesty-humility. This factor describes an individual's level of sincerity in interactions with others, willingness to take advantage of others for personal gain, preference for or motivation to obtain high status, and modesty. Honesty-humility has been examined across a number of contexts, such as the workplace (Johnson, Rowatt, & Petrini, 2011), academic settings (de Vries, de Vries, & Born, 2011), and in laboratory studies examining decision-making in

social dilemmas (Zettler, Hilbig, & Heydasch, 2013). Extensive research has also examined the relationship between the ‘H Factor’ and antisocial behaviour, with findings indicating that individuals reporting low levels of honesty-humility are more likely to engage in counterproductive academic behaviours (de Vries et al., 2011), workplace delinquency (Lee, Ashton, & de Vries, 2005), violent behaviour (Pailing, Boon, & Egan, 2014), and illegal activity (Rolison, Hanoch, & Gummerum, 2013). Comparative research has found that the HEXACO outperforms the FFM in predicting variables such as materialism, delinquency, unethical decision-making, and social adroitness (Ashton & Lee, 2008).

Perhaps unsurprisingly, the HEXACO model also outperforms the FFM in the assessment of ‘dark triad’ variables (primary psychopathy, Machiavellianism, and narcissism) – variables characterized by features captured primarily by honesty-humility and its facets (Lee & Ashton, 2005). With regard to psychopathy, other research has found significant associations with HEXACO honesty-humility and emotionality, despite a non-specific association between psychopathy and FFM neuroticism (Gaughan, Miller, & Lynam, 2012).

In addition to the empathy or sentimentality that may inhibit one from taking advantage of others, levels of fearfulness within HEXACO emotionality may inhibit one from engaging in risky behaviours. For instance, stronger associations have been found with regard to HEXACO emotionality as compared to FFM neuroticism in relation to specific phobias (Ashton, Lee, Visser, & Pozzlebon, 2008), and higher levels of emotionality are associated with elevated perceptions of risk (Weller & Tikir, 2011).

The separation of anger-related aspects from the fear and anxiety that were originally under FFM neuroticism allows for a theoretical explanation for altruistic behaviour. While individuals high in honesty-humility are unwilling to take advantage of others even in conditions

in which they can get away with it, individuals high in agreeableness are willing to cooperate even in conditions in which they are being taken advantage of. Together, these two factors represent individual differences in the tendency toward reciprocal altruism (Ashton, Lee, & de Vries, 2014). The fearfulness and empathic concern that characterize emotionality, on the other hand, represent individual differences in the tendency toward kin altruism. While an individual may miss out on the potential benefits of risk-taking, higher levels of fearfulness may reduce the likelihood of harm to oneself or close others (Ashton & Lee, 2007).

### **HEXACO and Addictive Behaviours**

Few published studies to date have examined the HEXACO model specifically in relation to addictive behaviours. One study included substance abuse as a component of counterproductive academic behaviour in an examination of its relationship with HEXACO traits (de Vries et al., 2011). Among the six traits, conscientiousness and honesty-humility demonstrated the strongest associations with counterproductive academic behaviour, with significant associations found at the facet level within these traits as well. With this single, no other known study has compared HEXACO dimensions amongst substance users. Yet, despite the limited existing evidence supporting the HEXACO in relation to addictive behaviours, this model of personality may be relevant to the field of addiction research. For instance, low levels of emotionality and honesty-humility have been identified as important correlates of risk-taking both to achieve gains as well as to avoid losses (Weller & Thulin, 2012). Risk-taking is an established risk factor for various addictions including AUD (Ashenurst, Jentsch, & Ray, 2011), GD (Gupta, Derevensky, & Ellenbogen, 2006), and SUDs (Ohannessian & Hesselbrock, 2008). However, other research suggests that dimensions of psychopathy concerning affective deficits, such as low levels of empathy and anxiety, may be associated with lower problem alcohol or

substance use or gambling symptom severity (Sellbom, Donnelly, Rock, Phillips, & Ben-Porath, 2017; Ručević, 2016). Thus, it is possible that low levels of emotionality may not only be associated with a greater likelihood of engaging in addictive behaviours, but also with a reduced likelihood of experiencing problems related to this engagement.

In addition to differences in emotionality, traits captured by honesty-humility, such as the willingness to cheat or manipulate others for personal gain, may differentiate those who engage in addictive behaviours from those who do not. Compared to normative samples, individuals with SUDs report higher levels of overt narcissism including entitlement and exploitativeness (Carter, Johnson, Exline, Post, & Pagano, 2012), and differences in manipulateness have been identified between never-, former, and currently-diagnosed AUD and SUD individuals (Hopwood et al., 2011).

### **HEXACO and Gambling Disorder**

While few investigations of HEXACO and substance use have been conducted, there have been recent empirical advances made in the gambling area. Recently, three experiments have examined the HEXACO model in relation to gambling. In the first, Laakasuo, Palomäki, and Salmela (2014) assessed the six dimensions in relation to level of poker experience among poker players. The results indicated a negative correlation between emotionality and number of hands played, level of stakes typically played at, and the extent to which players considered themselves to be professional poker players (Laakasuo, Palomäki, & Salmela, 2014). Due to the high level of skill involved for poker as compared to many other gambling activities, however, such results cannot be generalized to other gamblers. In addition, this particular study did not include a group of control participants, nor did it include a measure of gambling-related problems. Finally, Laakasuo and colleagues utilized a seven-point likert scale rather than the

five-point scale recommended by Ashton and Lee (2009), complicating attempts to compare mean scores in this particular study with those obtained from normative samples. Thus, the conclusions that are able to be drawn from this particular study regarding gambling experience and HEXACO personality dimensions are limited.

The HEXACO model has recently been studied in relation to gambling behaviour in a sample of university students (McGrath, Neilson, Lee, Rash, & Rad, 2018). Both self-reported and observer-reported HEXACO traits were analyzed in relation to gambling status (non-gamblers versus gamblers) and GD symptoms. Of the six HEXACO factors, it was found that self- and observer-reported levels of honesty-humility differentiated gamblers from non-gamblers, suggesting that higher levels of honesty-humility may serve as a protective factor against gambling at risky or problematic levels. Moreover, increased levels of GD severity were predicted by self- and observer-reported agreeableness as well as self-reported conscientiousness and honesty-humility. The relationship between low levels of conscientiousness and greater GD severity are in line with previous research on personality and addictive behaviours in general (Malouff et al., 2006, 2007) as well as gambling in particular (MacLaren et al., 2011; Williams et al., 2015), and the role of HEXACO agreeableness in GD severity supports past findings indicating that FFM agreeableness, particularly the straightforwardness facet, are associated with GD severity (MacLaren et al., 2011).

McGrath and colleagues' (2018) paper also examined the mediating role of gambling motives in the link between HEXACO traits and GD severity. It was found that participants reporting lower levels of honesty-humility were more likely to report gambling for intrinsic reasons (e.g., to regulate emotions) and due to a desire for financial gain, rather than for social reasons. With regard to the agreeableness-GD severity link, gambling to reduce negative affect

(i.e., coping motives) was a significant mediator. Finally, no gambling motives significantly accounted for the relationship between low levels of conscientiousness and GD severity.

Findings such as these suggest that individuals low in honesty-humility may experience problems with gambling as a result of behaviour motivated by hedonistic desire (e.g., gambling for pleasure or to win a jackpot) or poor coping strategies (e.g., gambling to alleviate negative emotion). Individuals low in agreeableness, on the other hand, may develop problems with their gambling due to using gambling as a way to cope with unpleasant emotional experiences. However, it is also possible that increases in GD severity may affect both features of one's disposition as well as one's motives for gambling. For instance, restlessness or irritability as a result of attempting to reduce one's gambling is included in the diagnostic criteria for GD in the DSM-5 (APA, 2013). An individual with low tolerance for negative emotions may, in turn, cope with such feelings by continuing to gamble despite a desire to reduce this behaviour.

In a more recent follow-up study, Kim, Rash, & McGrath (in press) investigated the HEXACO model in a sample of community-recruited gamblers, who were directly compared to a community sample of lifetime non-gamblers. Controlling for demographic variables, once again honesty-humility significantly predicted gambling (versus non-gambling) status. Specifically, participants with lower levels of honesty-humility were more likely to be gamblers. Among gamblers, lower levels of honesty-humility, conscientiousness, and openness to experience were predictive of greater levels of gambling severity, controlling for demographic factors.

The role of gambling motives in the relationship between honesty-humility and GD severity was also examined. Kim and colleagues (in press) extended McGrath and colleagues' study (2018) by entering all four gambling motives (social, enhancement, coping, and financial)

into one model, thereby allowing for an examination of the role of individual motives while controlling for the effects of others. Controlling for participant age and gender, coping motives emerged as the only significant mediator in the relationship between honesty-humility and GD severity. Moreover, the direct honesty-humility-GD relationship was no longer significant with the inclusion of gambling motives in the model. While no empirical literature has examined why this may be the case, it is possible that individuals low in honesty-humility – that is, individuals who may be more materialistic and more prone to feelings of entitlement – may be more susceptible to experiencing emotional distress, which they may try to manage through maladaptive coping strategies (Donnelly, Ksendzova, Howell, Vohs, & Baumeister, 2016; Grubbs & Exline, 2016).

Despite limited empirical evidence exploring the relationship between HEXACO traits and addiction, the association between honesty-humility-type descriptors and addictive behaviours have been identified, and some of these variables have been incorporated into diagnostic criteria for certain addictive behaviours. While tendencies toward interpersonal manipulation or exploitation of others likely do not characterize all individuals with addictions, the extent to which some individuals experience problems related to addictive behaviours may be related to the motivation to manipulate others to obtain money or substances necessary to support one's habit, or lie to hide the extent of the problem. Notably, the DSM-5 includes deception as one criterion for GD diagnosis, and lying to others about the extent of one's gambling involvement is one of two criteria in the Lie-Bet Screen for GD (Johnson et al., 1997). Research indicates that many GDs report lying to close others in order to conceal large financial losses (Stinchfield, 2002). Higher levels of manipulateness and deceitfulness have been identified as risk factors for GD (Carlotta et al., 2015); moreover, narcissistic traits predict gambling

frequency, gambling expenditure, and greater GD symptom severity, suggesting that the high confidence expressed by individuals with these traits and the tendency to focus primarily on potential rewards while discounting potential losses may increase the likelihood of experiencing more severe gambling-related problems (Lahey, Rose, Campbell, & Goodie, 2008). Additionally, many gamblers report being motivated to gamble for materialistic reasons, such as winning a large jackpot or being able to buy and show off expensive possessions (Dechant, 2014; Gillespie, Derevensky, & Gupta, 2007). Given that no analogue for the honesty-humility facet of greed avoidance exists within the FFM, it is perhaps unsurprising that the HEXACO model of personality has been found to be superior to the FFM for predicting materialism (Ashton & Lee, 2008).

### **The Present Study**

At present, only gambling has been examined in the relationship between HEXACO personality dimensions and addictive behaviours. Findings from the two studies assessing GD severity have indicated that honesty-humility appears to be a particularly important trait to consider; however, it is unclear whether such results are generalizable to other addictive behaviours or if they are unique to gambling. Moreover, while the role of personality has been assessed with regard to AUD, GD, and SUDs. The SUDs that many studies have focused on have tended to involve infrequently-used (National Institute on Drug Abuse [NIDA], 2016) and often illicit substances (e.g., Gupta et al., 2017; Koller, Preuss, Lü, Soyka, & Pogarell, 2015; Lackner et al., 2013; Quirk & McCormick, 1998; Raketich et al., 2017; Terracciano et al., 2008). Thus, the extent to which the personality profiles of those who engage in addictive behaviours that are largely legal, accessible, and prevalent differ from one another is unclear. To address gaps in the literature, the present study compared HEXACO traits across four groups of

individuals: alcohol use disorder (AUDs), cannabis use disorder (CUDs), gambling disorder (GDs), and a group of healthy controls (HCs) free of addictive disorders. Participants completed a questionnaire battery assessing demographic characteristics, substance use and addictive behaviours, and personality as measured by the HEXACO model. Given findings from existing literature comparing addictive behaviours to healthy controls and to one another in relation to personality dimensions, it was hypothesized that:

H<sub>1</sub>: Relative to HCs, AUDs would report lower levels of agreeableness, conscientiousness, and honesty-humility.

H<sub>2</sub>: Relative to HCs, CUDs would report lower levels of agreeableness and honesty-humility, and higher levels of openness to experience.

H<sub>3</sub>: Relative to HCs, GDs would report lower levels of conscientiousness and honesty-humility.

In addition to comparisons between HCs and AUDs, CUDs, and GDs, the present study also aimed to determine whether differences between AUDs, CUDs, and GDs could be identified. Given the small body of empirical evidence examining HEXACO personality traits and gambling, as well as the absence of empirical evidence examining HEXACO and other addictive behaviours, the present study also aimed to compare the AUD, CUD, and GD groups to one another. Synthesizing existing HEXACO-gambling findings and past research on cannabis, alcohol, and the FFM, it was hypothesized that:

H<sub>4</sub>: Relative to AUDs and GDs, CUDs would report higher levels of openness to experience.

H<sub>5</sub>: Relative to AUDs and CUDs, GDs would report lower levels of honesty-humility.

## Method

### Participants

Prior to conducting analyses, all submissions were screened to exclude duplicate submissions, submissions from outside of the United States, and invalid and/or incomplete responses. This process is discussed in further detail in the Results section. After data screening and cleaning, the final sample consisted of a total of 308 participants: 112 AUDs; 73 CUDs; 41 GDs; and 82 HCs. A slight majority (53.6%) were female, with a mean age of 39.23 years ( $SD = 12.18$ ). The sample was primarily Caucasian (79.9%), and nearly two-thirds (63.6%) reported some level of post-secondary education. Slightly over half of participants (54.5%) were employed full-time. Participants reported a range of household income levels, with 15.6% earning below \$20,000 per year, 28.2% between \$20,000 and \$40,000, 18.8% between \$40,000 and \$60,000, 17.5% between \$60,000 and \$80,000, 7.5% between \$80,000 and \$100,000, and 12.3% reported earning over \$100,000 per year. Less than half (41.6%) of the total sample was single, 49.0% were married or common-law, and 9.4% were divorced or separated.

### Measures

*Demographics.* An author-created demographic questionnaire was used to collect potentially relevant demographic information, including participant age, sex, ethnicity, marital status, occupational status, and educational attainment. This demographic measure has been used in previous research conducted by our team (e.g., Kim & Hodgins, 2017; Rash & McGrath, 2017; Rash, Kim, Hodgins, & McGrath, 2018).

*Alcohol use.* The Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, de la Fuente, & Grant, 1993) is a 10-item measure assessing the level of harm experienced as a result of one's alcohol consumption. Participants reported the extent to which they engaged in

each indicator of problem alcohol use or experienced each alcohol-related problem. Each of the 10 items yields a score between 0 and 4, with a maximum total score of 40 and a score of 8 or higher indicative of problematic alcohol use. The AUDIT has been shown to be a sensitive and specific measure, and demonstrates acceptable internal reliability and construct validity (Reinert & Allen, 2002).

During the screening process, particular attention was paid to the first three questions within the AUDIT, referred to as the AUDIT-C (Bush, Kivlahan, McDonell, Fihn, & Bradley, 1998). These three questions assess one's typical alcohol consumption quantity and frequency over the past 12 months. A total cut-off score of 3 for the AUDIT-C is indicative of hazardous alcohol use (Gómez, Conde, Santana, & Jorrín, 2005). Thus, individuals who scored within the low-risk limits for the total AUDIT (i.e., a score of 0-7) but received a score of 3 or above on the AUDIT-C were ineligible to participate. In the present study, Cronbach's alpha for the full AUDIT and the AUDIT-C were .91 and .86, respectively.

*Cannabis use.* Participants completed the six-item Cannabis Abuse Screening Test (CAST; Legleye, Karila, Beck, & Reynaud, 2007), which assesses problems as a result of cannabis use over the previous 12 months. Participants indicated on a five-point likert scale (0 = never, 4 = very often) how often over the past 12 months they had experienced each problem as a result of their cannabis use. Scores on the CAST range from 0 to 24, with scores of 3 or higher indicative of moderate cannabis-related problems and scores of 5 or higher indicative of severe cannabis-related problems in general population samples. The CAST demonstrates good psychometric properties and convergent validity, with higher mean scores reported by those who have considered seeking help for their cannabis use or have experienced problems at home or at work

due to their cannabis use (Legleye et al., 2015). Internal consistency of the CAST in the present study was acceptable (Cronbach's alpha = .71).

*Problem gambling.* The nine-item Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001) assesses the degree to which an individual has experienced problems related to gambling over the past year. Participants indicated the extent to which they had experienced each gambling-related problem on a four-point likert scale (0 = never; 3 = almost always), with higher scores indicating greater problem gambling severity. The maximum PGSI score is 27, and scores can be categorized into four groups: non-problem gambling (scores of 0), low-risk gambling (scores of 1 or 2), moderate-risk gambling (scores of 3-7), and problem gambling (scores of 8 or higher). The PGSI was developed for use in general population samples and has been found to be a reliable and valid measure of problem gambling (Wynne, 2002). In the present study, Cronbach's alpha was .96.

*Personality.* All participants completed the 100-item self-report version of the HEXACO Personality Inventory-Revised (HEXACO-100; Lee & Ashton, 2018), assessing the six personality dimensions within the HEXACO framework and the four facets within each higher-order dimension. Participants indicated on a five-point likert scale the extent to which they felt that each statement described them (1 = strongly disagree; 5 = strongly agree). The HEXACO-100 has demonstrated adequate reliability and validity at both the factor and facet levels in online samples (Lee & Ashton, 2018). The present study obtained Cronbach's alpha values of .83, .77, .86, .84, .80, and .83 for the honesty-humility, emotionality, extraversion, agreeableness, conscientiousness, and openness scales, respectively.

*Other substance use.* A checklist modified from the World Health Organization's (WHO) Alcohol, Smoking, and Substance Involvement Screening Test (ASSIST 3.0; WHO ASSIST

Working Group, 2002) was used to assess other substance use. Participants were asked to indicate which of seven substances (hallucinogens; cocaine; amphetamine, methamphetamine, or other stimulants; inhalants; opiates; nonmedical use of sedatives, sleeping pills, or minor tranquilizers; other) they had used in the past 12 months. This checklist has been used in past research with addictive behaviours (e.g., Williams et al., 2015).

*Other substance abuse.* In order to ensure that potentially comorbid SUDs did not confound results, participants who reported past-year use of any of the above-mentioned substances completed the 10-item Drug Abuse Screening Test (DAST-10; Skinner, 1982). Participants reported in a yes/no format whether they had experienced each of 10 consequences related to the use of any of the substances they selected above (i.e., excluding alcohol or cannabis). The DAST demonstrates moderate to high levels of reliability, validity, sensitivity, and specificity, and has been used in community and clinical samples (Yudko, Lozhkina, & Fouts, 2007). A score of 3 or higher on the DAST-10 is indicative of substance abuse or dependence (Skinner, 1982). In the present study, Cronbach's alpha was .82.

*Psychological distress.* Participants completed the 21-item Depression Anxiety Stress Scales (DASS-21; Lovibond & Lovibond, 1995). This measure consists of three subscales, each measuring a separate element of psychological distress (depression, anxiety, and stress). The DASS-21 demonstrates acceptable to excellent reliability and validity and is appropriate for use in clinical and community samples (Antony, Bieling, Cox, Enns, & Swinson, 1998; Henry & Crawford, 2005). Cronbach's alpha values for the stress, anxiety, and depression scales were .89, .84, and .95, respectively.

## **Procedure**

Recruitment of participants took place on two online crowdsourcing platforms. The first, Amazon's Mechanical Turk (MTurk), is a resource found to yield rapid collection of data that is comparable to that obtained from both online panels and student samples (Chandler & Shapiro, 2016). Within the field of addictions research, MTurk has been found to be a useful resource for collecting data from individuals reporting potential substance abuse problems (Shapiro, Chandler, & Mueller, 2013), and recent findings indicate that the use of MTurk for this purpose produces valid and reliable data for alcohol use and gambling populations; however, the same study encouraged caution with regard to cannabis populations (Kim & Hodgins, 2017). Knowing this, cannabis use was assessed using a more reliable measure and a second recruitment platform in the present study.

In addition to MTurk, participants were also recruited via TurkPrime. While both have been found to be efficient and valid recruitment tools (Chandler & Shapiro, 2016; Litman, Robinson, & Abberbock, 2017), TurkPrime was created for academic research purposes while MTurk was not (Litman et al., 2017). Comparison of the two platforms has led some to recommend the use of TurkPrime rather than MTurk for conducting organizational research studies (Keith, Tay, & Harms, 2017). However, it is unclear whether workers on the two platforms differ from one another with regard to other types of research (e.g., addictions).

Four separate recruitment notices were posted on each platform. Each notice outlined eligibility criteria and a description of the research. Individuals in the three addictive behaviour groups were eligible for screening if they were between the ages of 21 and 65 years and had consumed alcohol once a week or more often over the previous 12 months (AUDs; Dawson, Grant, & Li, 2005), had used cannabis once a week or more often over the previous 12 months (CUDs; Davis, Thomas, Jesseman, & Mazan, 2009), or had gambled once a week or more often

over the previous 12 months (GDs; Currie et al., 2006, 2008). Healthy controls were those individuals between the ages of 21 and 65 years who had engaged in one or more of the behaviours of interest weekly over the previous 12 months. Though many individuals who engage in one addictive behaviour often engage in others (e.g., Kairouz, Dussault, & Monson, 2018; Larsen, Curtiz, & Bjerregaard, 2013), the present study examined only differences between ‘pure’ groups. That is, individuals who received a score above the cut-off for more than one addictive behaviour were not eligible to participate. This strategy was chosen in an effort to address shortcomings of previous literature, which have addressed the issue of comorbidity in a number of ways: by addressing only a participant’s ‘primary’ addiction (Zilberman et al., 2018); statistically controlling for the effects of comorbid addictions (Flory et al., 2002); or grouping all comorbid individuals into a single group, thereby ignoring potential differences between individuals with different comorbid addictive disorders (Lackner et al., 2013). Thus, it was determined that isolating single addictive disorders during the recruitment process would yield the clearest data for the present study.

Interested workers completed a screening measure to assess their eligibility. The purpose of this screening measure was to verify engagement in the target behaviour and to assess problematic levels of involvement for individuals in the AUD, CUD, and GD groups and to identify healthy controls. With regard to the three addictive behaviour groups, those individuals who had engaged in the target behaviour in the previous 12 months completed the AUDIT, CAST, and/or the PGSI. Only those who scored at or above the cut-off score for problem levels of involvement (15 or higher on the AUDIT, 7 or higher on the CAST, and 8 or higher on the PGSI) for one of the three were eligible to continue. With regard to HCs, those participants who scored below 3 on the AUDIT-C and below 8 on the full AUDIT, below 2 on the CAST, and

below 3 on the PGSI were eligible to continue. A detailed description of the recruitment strategy is displayed in Figure 1.

Participants who were deemed ineligible were redirected to an ineligibility notice, and eligible participants were redirected to an online consent form. Those who provided informed consent completed an online questionnaire battery hosted by Qualtrics, which was expected to take approximately 25 minutes. Following completion of the survey, participants were debriefed and compensated with \$2.50.

### **Data Analysis**

Given the high comorbidity rates between different addictive behaviours (Kairouz et al., 2018; Larsen et al., 2013), efforts were made in the present study to control for the confounding effect of SUDs beyond those of interest. Thus, data from participants who reported other substance use and scored above the cut-off on the DAST-10 were excluded from main analyses.

Similarly, given the high comorbidity between addictive disorders and other psychological disorders (Agosti, Nunes, & Levin, 2002; Lorains et al., 2011; Stinson et al., 2005), the present study took levels of depression, anxiety, and stress into consideration. Scores for each of the three DASS-21 subscales were controlled for in analyses.

Another consideration for the proposed study was the effects of participant gender. The HEXACO model of personality acknowledges significant gender differences, with females scoring higher than males on emotionality and honesty-humility, and to a lesser extent conscientiousness. Males have been found to score higher than do females on self-reported openness to experience (Lee & Ashton, 2006). Within each factor, differences between males and females exist at the facet level (Lee & Ashton, 2004); thus, a secondary aim of the present

study was to examine the possible interaction effects of gender X group on personality dimensions.

All analyses were performed using SPSS version 24. Differences between the three addictive behaviour groups and HCs were analyzed using a multinomial logistic regression analysis, with group membership (HCs as the reference group) as the criterion and the six HEXACO factors as predictors. Participant age, gender, and levels of stress, anxiety, and depression were included in analyses as covariates. An exploratory approach was also taken with regard to the facets within HEXACO personality factors, with significant factors followed up using binary logistic regression analyses at the facet level where applicable.

Differences between the three addictive behaviour groups on the six HEXACO personality dimensions were examined using a one-way multivariate analysis of covariance (MANCOVA). Significant findings were investigated with post-hoc LSD tests. Significant factors were further explored at the facet level using multinomial logistic regression analyses where applicable.

### **Ethical Approval**

The Conjoint Faculties Research Ethics Board at the University of Calgary has approved of this research study (ID: REB17-1984). Participants were informed of their role in the study and the voluntary nature of their participation, and they were made aware that they may withdraw from the study at any time without penalty.

## Results

A total of 23,241 submissions (study screening and/or participation) were screened. Of these, 435 were submitted by individuals located outside of the United States and were excluded. A total of 8,218 were duplicate submissions identified by Geolocation or IP addresses. In the case of duplicate submissions, the earliest was retained and any others were flagged and excluded. Of the remaining 14,588 submissions, 2,903 individuals were excluded on the basis of age restrictions; 4,767 reported no weekly alcohol consumption, cannabis consumption, or gambling over the past 12 months; and 2,923 did not report engaging in the behaviour of interest. Of the 3,995 participants who completed the AUDIT, CAST, and/or the PGSI, 2,387 were excluded on the basis of 'grey-area' scores (i.e., 8-14 total AUDIT score and/or 0-7 total AUDIT and 3+ AUDIT-C scores and/or 3-6 CAST score and/or 3-7 PGSI score); 626 were excluded due to comorbidity (i.e., 15+ AUDIT and/or 7+ CAST and/or 8+ PGSI); 94 were excluded due to meeting criteria for an addictive behaviour other than the one of interest; and 414 were excluded due to meeting criteria for the HC group when screening for participation in one of the addictive behaviour groups. Thus, a total of 459 individuals were eligible to participate. Of these, 18 did not consent to participate; 87 submissions were incomplete or invalid based on HEXACO-100 responses; and 45 submissions were flagged for scores of 3 or higher on the DAST-10. Finally, one participant was identified as an influential case and was excluded, leaving a total of 308 valid responses. Demographic characteristics and survey descriptives are reported in Table 1.

### Preliminary analyses

To determine whether differences existed between participants recruited via MTurk and those recruited through TurkPrime, a series of independent-samples t-tests and chi-square analyses were run on AUDIT, CAST, and PGSI scores, as well as demographic variables.

Relative to TurkPrime participants, MTurk participants were younger and were more likely to be male, employed full-time, to report education beyond high school, and to be single.

To determine whether differences existed between participants who received a score of 3 or above on the DAST-10 and those who did not, another series of independent-samples t-tests and chi-square analyses were run on AUDIT, CAST, PGSI, and HEXACO scale scores in addition to demographic variables. Individuals scoring 3 or higher on the DAST-10 had significantly higher AUDIT Total, AUDIT-C, CAST, and PGSI scores. Those scoring 3 or higher were also younger than individuals who were included in the present study. With regard to HEXACO variables, those scoring 3 or higher on the DAST-10 reported significantly lower levels of honesty-humility, emotionality, and conscientiousness.

### **Intercorrelations between study variables**

Bivariate correlational analyses were performed on all variables intended to be included in main analyses, both for the total sample and separated by group (see Tables 2 through 6). Low to moderate intercorrelations were observed for the majority of variables; however, the high intercorrelations between DASS-21 subscale scores indicated that inclusion of each subscale in analyses was redundant ( $r_s = .78-.94$  in the total sample). Thus, a total DASS-21 score was computed and used in main analyses.

### **Comparisons between HCs and AUDs, CUDs, and GDs**

Of the 308 participants who provided valid responses to the HEXACO-100, 67 participants did not complete the DASS-21. As multinomial logistic regression employs listwise deletion, the sample size for this analysis was reduced to 241 participants. Addition of the predictors and control variables to an intercept-only model improved the model fit,  $\chi^2(27, N = 241) = 98.72$ , Nagelkerke  $R^2 = .36$ ,  $p < .001$ . Significant contributions were made by participant

age ( $p = .004$ ), DASS-21 total score ( $p = .001$ ), and HEXACO honesty-humility ( $p = .001$ ), conscientiousness ( $p = .016$ ), and openness to experience scores ( $p = .021$ ). This model correctly classified 52.3% of cases, compared to 36.4% for an intercept-only model.

Results are summarized in Table 7. Controlling for participant age, gender, and DASS-21 scores, higher honesty-humility scores were associated with a significantly lower likelihood of being classified in the AUD ( $OR = 0.46$ ) and GD groups ( $OR = 0.31$ ). Higher conscientiousness scores were associated with a lower likelihood of being classified in the AUD group ( $OR = 0.26$ ). Finally, higher openness to experience scores were associated with a significantly greater likelihood of being classified in the CUD group ( $OR = 2.13$ ).

#### **Post-hoc facet-level exploratory analyses**

Significant findings were followed up with a series of multinomial and binary logistic regressions, presented in Tables 8 through 10. Classification in the AUD relative to the HC group was predicted by lower scores on honesty-humility fairness ( $OR = 0.54$ ) and greed avoidance facets ( $OR = 0.58$ ) and the prudence facet within conscientiousness ( $OR = 0.36$ ). Classification in the CUD group relative to HCs was predicted by higher scores on the openness to experience facet of creativity ( $OR = 2.12$ ). Finally, classification in the GD group was predicted by lower scores on honesty-humility greed avoidance ( $OR = 0.34$ ).

#### **Comparison between AUDs, CUDs, and GDs**

Results of Box's M test which indicated that observed covariance matrices of the dependent variables were not equal across groups ( $p < .001$ ). Given the significance level and the unequal sample sizes, results of the omnibus MANCOVA should be considered with caution (Tabachnick & Fidell, 2001).

Results of the MANCOVA analysis are shown in Table 11. The omnibus model was significant,  $F(12, 330) = 3.23, p < .001$ , Pillai's Trace = .21. Controlling for participant age, gender, and DASS-21 total score, between-groups analyses revealed significant group differences in HEXACO honesty-humility ( $F(2, 169) = 9.20, p < .001$ ), conscientiousness ( $F(2, 169) = 5.31, p = .006$ ), and openness to experience ( $F(2, 169) = 7.77, p = .001$ ). Post-hoc pairwise comparisons revealed that AUDs scored lower than did CUDs on honesty-humility ( $p < .001$ ), conscientiousness ( $p = .001$ ), and openness ( $p = .001$ ). GDs also scored lower than did CUDs on honesty-humility ( $p < .001$ ), conscientiousness ( $p = .001$ ) and openness ( $p = .001$ ). No significant differences were identified between AUDs and GDs.

#### **Post-hoc facet-level exploratory analyses**

To follow up significant differences identified in the MANOVA, multinomial logistic regression analyses were performed for the facets of honesty-humility, conscientiousness, and openness to experience, with CUDs as the reference group against AUDs and GDs. All analyses controlled for participant gender, age, and DASS-21 score.

Results of the post-hoc analyses are shown in Tables 12 through 14. Results of the multinomial regression analysis on honesty-humility facets indicated that lower scores on the sincerity ( $OR = 0.58$ ) and greed avoidance facets ( $OR = 0.55$ ) were predictive of AUD. Higher scores on fairness ( $OR = 1.79$ ) and lower scores on greed avoidance ( $OR = 0.34$ ) and modesty ( $OR = 0.44$ ) were predictive of GD. The multinomial regression analysis on conscientiousness facets indicated that lower prudence scores were associated with a greater likelihood of being classified in the AUD group ( $OR = 0.52$ ). None of the individual facets were statistically significant with regard to GDs. Finally, the multinomial regression analysis on openness to experience facets indicated that lower creativity scores were associated with an increased

likelihood of classification in the AUD group ( $OR = 0.53$ ); on the other hand, lower unconventionality scores were associated with an increased likelihood of classification in the GD group ( $OR = 0.36$ ).

## **Discussion**

The aim of the present study was to extend existing research on personality and addictive behaviours by comparing individuals with AUD, CUD, and GD to HCs and to one another on HEXACO personality traits. It was hypothesized that the three addictive behaviour groups would present with unique personality profiles when compared to HCs and to one another. As discussed below, these hypotheses were not entirely supported.

### **Hypothesis 1**

Relative to HCs, it was hypothesized that AUDs would report lower levels of agreeableness, conscientiousness, and honesty-humility as measured by the HEXACO model of personality. While no differences in HEXACO agreeableness were identified, AUDs reported significantly lower levels of conscientiousness and honesty-humility relative to HCs. Findings regarding agreeableness may highlight the differences between the FFM and HEXACO frameworks, as the former captures many elements of HEXACO honesty-humility. Given the significant differences in honesty-humility scores between AUDs and HCs in the present study, this may indeed be the case.

At the facet level, differences in levels of fairness and greed avoidance appeared to be driving the difference in honesty-humility scores between AUDs and HCs. As mentioned previously, low scores on the fairness subscale reflect a greater willingness to achieve personal gain by cheating or stealing, whereas low scores on the greed avoidance subscale reflect a greater interest in obtaining material possessions and indicators of high social status. Past research on alcohol use and academic dishonesty has found a positive relationship between college students' level of alcohol consumption and self-reported cheating on exams (Burrus, McGoldrick, & Schuhmann, 2007), and higher levels of materialistic values and goals have been found to be

associated with alcohol consumption (Williams, Cox, Hedberg, & Deci, 2000). As the present study was cross-sectional, it is unclear whether lower honesty-humility scores in general, and fairness and greed avoidance scores in particular, increase one's likelihood of AUD, whether such tendencies are amplified among individuals with AUD, or whether the personal and social consequences of excessive alcohol consumption influence elements of honesty-humility.

It is also possible that controlling one's alcohol consumption is more difficult among low honesty-humility individuals. For example, it is likely that a low honesty-humility individual may be less concerned with the needs, values, and feelings of close others who are negatively impacted by his or her excessive drinking and thus may not be motivated to cut back until he or she experiences additional or more severe consequences, at which point controlling one's drinking may be more difficult to do (e.g., Jonason & McCain, 2012; Ogunfowora & Bourdage, 2014). Alternatively, the greater likelihood of utilizing deceptive impression management techniques among individuals with lower honesty-humility scores (Roulin & Bourdage, 2017) may hinder an individual and his or her social network from recognizing or acknowledging problematic alcohol consumption until AUD symptoms are more severe. Finally, it is possible that low honesty-humility may facilitate the transition from heavy drinking to AUD, with such individuals potentially being more willing to exploit others' trust and kindness in an effort to maintain an addictive behaviour and avoid negative consequences.

As expected, AUDs reported significantly lower levels of conscientiousness than did HCs. The groups differed primarily on the prudence facet, which reflects one's tendency to behave in a cautious manner, to consider the consequences of one's actions, and to inhibit impulses. Such findings are in line with previous research: alcohol consumption is associated not only with lower levels of FFM conscientiousness (Malouff et al., 2007) but also with the

impulsiveness facet within FFM neuroticism (Ruiz et al., 2003), which captures elements of the HEXACO prudence facet (i.e., difficulty resisting impulses) and is correlated with FFM conscientiousness (McCrae, Costa, & Martin, 2005).

## **Hypothesis 2**

It was hypothesized that CUDs would report lower levels of HEXACO agreeableness and honesty-humility and higher levels of openness relative to HCs. While no differences were observed with regard to agreeableness or honesty-humility, as predicted, CUDs reported higher levels of openness to experience. This finding mirrors results obtained by previous research assessing levels of openness to experiences in cannabis users and CUDs (e.g., Flory et al., 2002; Terracciano et al., 2008). Upon closer inspection, differences between CUDs and HCs were found to be driven by the creativity facet – that is, CUDs reported greater interest in artistic endeavours and considered themselves to be more imaginative than did HCs. While the FFM does not have a facet of openness to experience that directly parallels the HEXACO creativity facet, previous research indicates that relative to current users, never-users and former users of cannabis report significantly different levels of FFM openness to experience facets of aesthetics (artistic interest), actions (willingness to experiment), and ideas (intellectual curiosity). On the other hand, former and current users of cannabis were found to significantly differ from never-users with regard to the values facet (tolerance for diversity and liberal values) (Terracciano et al., 2008). Given that HCs were not differentiated based on their experience with alcohol, cannabis, or gambling (i.e., many HCs did not report weekly use of cannabis), it is possible that differences in other facets of openness – and potentially other HEXACO traits – may have been identified had CUDs been compared against a group of non-problem regular cannabis users.

Though existing findings are inconsistent, research examining the relationship between cannabis use and openness to experience suggests that cannabis users may be more creative than non-users. Relative to non-users, cannabis users are more likely to pursue creative and artistic interests (Plucker & Dana, 1998) and perform significantly better than do controls on measures of creative thinking (Jones, Blagrove, & Parrott, 2009). In addition to the tendency to engage in more creative activities, many individuals are motivated to use cannabis for its effects on creativity. Self-reported subjective effects of cannabis frequently include enhanced creativity (Green et al., 2003), and motives for cannabis use related to ‘expansion’ are associated with more frequent cannabis use as well as CUD symptom severity (Simons et al., 1998). While the cross-sectional nature of the present study does not allow for inferences of causality, it is possible that escalations in cannabis use and symptom severity may be more likely among individuals who seek its perceived effects on cognitive functioning, particularly among those who pursue creative interests.

### **Hypothesis 3**

Relative to HCs, it was hypothesized that GDs would report lower levels of conscientiousness and honesty-humility. In contrast to past findings described previously, the present study did not find a significant role of conscientiousness in classifying GDs and HCs. It is possible that differences in the present study may have been detected at the facet level within the HEXACO framework. McGrath and colleagues’ (2018) examination of undergraduate gamblers and non-gamblers did not identify differences between the two groups on HEXACO conscientiousness, but conscientiousness did predict GD severity among gamblers. Given the use of an undergraduate sample and that the mean PGSI score in that particular study was under 2

(the cut-off for non-problem gambling), it is perhaps not surprising that different results were obtained in the present study.

Alternatively, the observed lack of support for the GD-conscientiousness link may be due to the small number of GDs recruited for the present study. Kim and colleagues (in press) found differences only in levels of honesty-humility between lifetime non-gamblers and gamblers. Among gamblers, GD severity was predicted by conscientiousness, openness, and honesty-humility. As GD severity was assessed as a function of continuous PGSI scores, it is unclear whether categorical comparisons (e.g., no-risk or non-gambling vs. problem gambling, as in the present study) would have yielded the same results.

On the other hand, significantly lower levels of honesty-humility were observed among GDs as originally hypothesized. Unexpectedly, these differences did not appear to be driven by one's willingness to deceive or exploit others for personal gain; rather, GDs differed from HCs only on the facet of greed avoidance. Differences in greed avoidance observed in the present study support past empirical investigations which have found an association between GD and a financially-focused self-concept (Tasbri, Wohl, Eddy, & Thomas, 2017). Relative to non-problem gamblers, GDs are more preoccupied with money, view money as an indicator of status or influence, and use money to impress others (Blaszczynski & Nower, 2010). Other research indicates that higher scores on a measure of gambling-related cognitive distortions and biases are associated with being motivated to gamble for financial gain and beliefs that wealth and financial possessions are admirable and contribute to one's level of happiness (Hahn, Wilson, McRae, & Gilbert, 2013). Though causality cannot be inferred from the present study, GDs' lower levels of greed avoidance may suggest that a preoccupation with money and the importance of money to one's self-worth may be an important factor to consider in the development and maintenance of

GD. It is possible that individuals with lower levels of greed avoidance are more likely to gamble excessively; however, it is also possible that individuals who gamble excessively may incur large amounts of debt and become more focused on money as a result.

#### **Hypothesis 4**

The present study hypothesized that CUDs would report higher openness to experience scores relative to AUDs and GDs. This hypothesis was supported. Moreover, unique profiles were observed at the facet level. Compared to AUDs, CUDs scored higher on the openness facet of creativity. Though research indicates a positive effect of alcohol consumption on creativity (e.g., Jarosz, Colflesh, & Wiley, 2012; Norlander, 1999), it is likely that individuals who engage in frequent and excessive alcohol consumption may experience impairments in creative functioning. For instance, more frequent alcohol consumption has been found to be associated with lower levels of creative achievement among undergraduate students (Plucker & Dana, 1998a, b). Moreover, AUDs are significantly less likely to be employed in artistic or scientific professions (Kyaga et al., 2013).

GDs also scored significantly lower than did CUDs on openness to experience. While creativity appeared to be the driving force behind AUDs, differences between CUDs and GDs at the facet level were detected with regard to unconventionality. Categorical comparisons between groups of gamblers (i.e., no-risk, low-risk, moderate risk, problem) have indicated that GDs are less open to change (Chiu & Storm, 2010) and score lower on the values facet of FFM openness (Reid et al., 2011), adding support to the present findings of lower levels of unconventionality among GDs. Previous research has suggested that individuals with more conventional attitudes may be limited in their willingness to alleviate distress using more positive coping strategies (Myrseth et al., 2009). It is also possible that gamblers who prefer familiarity may be averse to

changing their gambling behaviour, thus increasing the likelihood that an individual will continue to gamble despite negative consequences.

### **Hypothesis 5**

Finally, it was hypothesized that GDs would report significantly lower levels of honesty-humility relative to AUDs and CUDs. While no significant differences in honesty-humility were observed between AUDs and GDs; however, CUDs differed significantly from both AUDs and GDs on this personality dimension. Given the similarity between CUDs and HCs on honesty-humility, it is possible that this pattern may reflect a more 'normative' personality profile among CUDs in the present study.

At the facet level, AUDs differed from CUDs with regard to sincerity and greed avoidance. Relative to CUDs, AUDs were significantly more willing to manipulate others for personal gain and were significantly more interested in wealth and social status. It is possible that low sincerity observed among AUDs may be related to consequences experienced as a result of excessive drinking; for example, an individual with an AUD may be less able to adequately provide for him or herself, particularly if he or she has experienced occupational consequences (e.g., loss of a job). Thus, an individual may manipulate close others into providing alcohol or money to maintain their addiction. With regard to greed avoidance, it is also possible that personal and financial consequences experienced by AUDs may contribute to a preoccupation with wealth and status. Alternatively, excessive alcohol consumption may serve as a maladaptive way of coping with feelings of relative deprivation (Mulia & Karriker-Jaffe, 2012).

Relative to CUDs, higher scores on the fairness facet was associated with a *greater* likelihood of being classified in the GD group. This finding may partially reflect limitations regarding sample size. Alternatively, it is possible that individuals with lower fairness scores

may be more willing to use cannabis in general. Gambling is a legal activity, while cannabis is illegal in many jurisdictions (National Conference of State Legislatures [NCLS], 2018), and this facet taps into willingness to engage in illegal behaviour for personal gain. In addition, low greed avoidance and modesty scores were significantly associated with GD. Given the central role of money in gambling, findings related to greed avoidance are perhaps not surprising. Low modesty, reflecting the belief that one is an important person entitled to more respect than others, may be conceptually related to greed avoidance in that an individual preoccupied with being viewed as superior to others may see wealth and material possessions as an integral component of this image.

### **Limitations and Future Directions**

Findings reported by the present study should be weighed against a number of limitations. First, participants from the two recruitment platforms differed with regard to both demographic variables and HEXACO personality dimensions, and these differences were not explored further or controlled for in analyses. Identification of differences between individuals recruited via TurkPrime as compared to MTurk indicates that this may be an important consideration for future research both within and outside of the field of addictive behaviours. At present, no research has directly compared users of the two crowdsourcing platforms; the present study provides a foundation to further explore this topic. Moreover, the high proportion of submissions which were screened out due to duplicate submissions and lack of attention to inclusion criteria may warrant increased attention to issues with the integrity of data obtained from participants using such platforms. Though behavioural research indicates greater diversity among participants recruited via online avenues versus face-to-face and virtually identical data quality (Casler, Bickel, & Hackett, 2013), online survey administration lacks a certain degree of

experimenter control afforded to in-person methods. In the present study, this was exemplified by duplicate submissions, responses submitted from outside of the United States, and attempts to participate despite not meeting basic inclusion criteria. Thus, an additional consideration for future research within the addictive behaviours field may be to compare the quality of data obtained from online platforms to that obtained from in-person recruitment methods.

An additional limitation involves sample size. It was originally intended to recruit a minimum of 90 participants per group; however, due to time and financial constraints, this goal was not attained with regard to three of the four groups, most notably GDs ( $n = 41$ ). As a result, it is possible that statistical analyses were underpowered and that different or stronger results would be obtained with a larger sample.

The present study also restricted analyses to individuals scoring above the cut-off on a single measure. That is, only ‘pure’ AUDs, CUDs, and GDs were included. As individuals who scored within the ‘grey area’ (i.e., low or medium risk) for any measure were screened out, it is unclear whether these individuals differ from individuals who scored above the cutoff on the variables of interest. A useful avenue for future research may be to determine whether AUDs, CUDs, and GDs represent a more extreme group compared to their at-risk counterparts.

Individuals with comorbid addictive behaviours were also ineligible to participate. The substance abuse literature indicates that polysubstance users present with a different personality profile as compared to individuals who use a single substance (McCormick et al., 1998). Indeed, the comparison between individuals with DAST-10 scores between 0 and 2 to those with scores of 3 and above indicated differences in honesty-humility, emotionality, and conscientiousness. While further exploration of this issue is beyond the scope of this study, the high rate of comorbid behavioural addictions and SUDs found in previous research (e.g., Lorains et al., 2011)

and the rate of comorbid SUDs among individuals in the present study (45 out of 353, or 12.5%) suggests that future research comparing a comorbid group to ‘pure’ addictive behaviour groups may be informative.

The present study also did not consider the context of substance use. This is particularly important with regard to CUD, as cannabis for medical use is legal in the majority of states (NCLS, 2018). Assessment measures such as the CAST may have been inappropriate for individuals who use cannabis for medical purposes, as such individuals may have qualified as CUDs based on responses to one or two items (e.g., cannabis use while alone or before midday). The lack of distinction between medical and recreational cannabis users in the present study may partially explain the relatively normative personality profile observed among CUDs. Similarly, the context of gambling behaviour was not examined. Gambling activities vary based on level of ‘skill’ required, extent of social interaction, event duration, and payout interval. GDs who gamble only on slot machines, for example, may differ in key ways from those who prefer table games or online gambling (Liu et al., 2018). Future research examining such variation among GDs in relation to HEXACO traits may provide greater insight.

As discussed previously, the cross-sectional design of the present study limits inferences related to causality. It is generally assumed that personality traits precede engagement in addictive behaviours (Wallace et al., 2016); however, this should not be interpreted to mean that personality traits are static and are not influenced by an individual’s experiences. A wealth of research indicates that certain traits are associated with an increased likelihood of risk-taking behaviours including substance use and gambling (Miller & Lynam, 2011), but the extent to which one’s personality changes *along with*, or *in response to*, engagement in such behaviours is also an important consideration. The corresponsive principle posits that personality traits which

increase the likelihood of certain experiences are deepened by those experiences (Caspi, Roberts, & Shiner, 2005). In the context of the present study, low levels of honesty-humility, for example, may serve as a risk factor for alcohol consumption or gambling at more frequent and excessive levels. As this behaviour becomes more problematic, such individuals may become more preoccupied with superficial concerns such as wealth and social status or be increasingly willing to exploit others for personal gain. The malleability of personality traits in response to life experience is deserving of greater attention to better understand the development and maintenance of addictive behaviours.

### **Practical Implications**

Results of the present study point to different personality profiles among individuals reporting problematic involvement in three normative and (to some extent) legal addictive behaviours. To the best of the author's knowledge, this is the first empirical investigation of the HEXACO model of personality in relation to AUD, CUD, and GD. Findings indicating the substantial role of honesty-humility in differentiating HCs from AUDs and GDs suggest that the FFM may be insufficient in studies aiming to understand the association between personality and addiction. Further support for this comes from results of facet-level analyses, which indicate the importance of greed avoidance (a dimension not covered by the FFM). Though the HEXACO and FFM models of personality were not compared to one another in the present study, the HEXACO model does appear to be a useful assessment tool in the field of addictive behaviours. In the future, studies using different designs, sample types, and addictive behaviours may extend the present findings and offer further insight into how individuals with various addictive behaviours differ from one another and from HCs.

The unique personality profiles of AUDs, CUDs, and GDs observed may have implications for the diagnosis and treatment of addictive behaviours. For instance, the lower levels of sincerity and greed avoidance in AUDs as compared to CUDs may highlight the need to be aware of the potential for interpersonal manipulation in assessment and treatment. Though the mechanism through which greed avoidance is associated with AUD is unknown, consideration of the importance of appearing wealthy or successful (and the consequences that may result from such preoccupation) may be an important treatment target. Similarly, GDs may also benefit from increased focus on the relationship between materialistic values and gambling behaviour, rather than attempting to correct erroneous cognitions (Fortune & Goodie, 2012). Finally, the higher levels of openness observed among CUDs as compared to the other three groups may encourage a more tailored approach to treatment for CUDs. It is possible that approaches emphasizing individual creativity and ‘thinking outside the box’ may be beneficial for this group; alternatively, the higher levels of openness among CUDs may translate into higher levels of receptiveness to behaviour change efforts.

### **Conclusion**

To address limitations of the FFM in the field of addictive behaviours, the present study aimed to determine whether AUDs, CUDs, and GDs differed from HCs and from one another. Despite widespread support for the FFM, results of the present study indicate that the HEXACO model of personality may be a useful assessment tool in addictions research. Unique personality profiles among the three addictive behaviour groups suggest that tailored treatment approaches addressing different facets of honesty-humility, conscientiousness, and openness to experience may be beneficial.

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Table 1. Demographic characteristics and survey descriptives.

Variable	Total sample ( <i>N</i> = 308) <i>M(SD)/n</i> (%)	AUDs ( <i>n</i> = 112) <i>M(SD)/n</i> (%)	CUDs ( <i>n</i> = 73) <i>M(SD)/n</i> (%)	GDs ( <i>n</i> = 41) <i>M(SD)/n</i> (%)	HCs ( <i>n</i> = 82) <i>M(SD)/n</i> (%)	<i>F/χ</i> <sup>2</sup>
Platform						5.36
MTurk	143 (46.4)	51 (45.5)	41 (56.2)	14 (34.1)	37 (45.1)	
TurkPrime	165 (53.6)	61 (54.5)	32 (43.8)	27 (65.9)	45 (54.9)	
Screening measures						
AUDIT Total <sup>a</sup>	12.78 (9.45)	19.71 (4.92)	1.50 (0.76)	2.00 (0.82)	2.23 (1.24)	295.82***
AUDIT-C <sup>a</sup>	4.98 (3.07)	7.09 (2.02)	1.50 (0.76)	1.75 (0.50)	1.77 (0.50)	162.20***
CAST <sup>b</sup>	7.80 (4.62)	0.50 (0.76)	9.66 (3.26)	--	1.33 (0.89)	68.16***
PGSI <sup>c</sup>	7.15 (7.50)	1.10 (0.88)	0.33 (0.58)	13.88 (5.04)	0.67 (0.92)	92.12***
Gender						6.04
Male	143 (46.4)	59 (52.7)	36 (49.3)	13 (31.7)	35 (42.7)	
Female	165 (53.6)	53 (47.3)	37 (50.7)	28 (68.3)	47 (57.3)	
Age	39.23 (12.18)	37.38 (11.07)	37.84 (11.51)	41.24 (12.06)	41.96 (13.73)	2.99*
Ethnicity						26.41**
Caucasian	246 (79.9)	85 (75.9)	66 (90.4)	33 (80.5)	62 (75.6)	
Asian	23 (7.5)	10 (8.9)	3 (4.1)	3 (7.3)	7 (8.5)	
Black	14 (4.5)	5 (4.5)	1 (1.4)	4 (9.8)	4 (4.9)	
Latin American	14 (4.5)	11 (9.8)	1 (1.4)	0 (0.0)	2 (2.4)	
Mixed	11 (3.6)	1 (0.9)	2 (2.7)	1 (2.4)	7 (8.5)	
Employment <sup>d</sup>						10.75
Full-time	168 (54.5)	67 (60.4)	34 (47.2)	22 (53.7)	45 (55.6)	
Part-time	47 (15.4)	20 (18.0)	9 (12.5)	7 (17.1)	11 (13.6)	
Casual/contract	8 (2.6)	2 (1.8)	4 (5.6)	0 (0.0)	2 (2.5)	
Unemployed	37 (12.1)	11 (9.9)	10 (13.9)	5 (12.2)	11 (13.6)	
Not in labour force	55 (18.0)	11 (9.9)	15 (20.8)	7 (17.1)	12 (14.8)	

Table 1 Continued

Variable	Total sample ( <i>N</i> = 308) <i>M(SD)/n</i> (%)	AUDs ( <i>n</i> = 112) <i>M(SD)/n</i> (%)	CUDs ( <i>n</i> = 73) <i>M(SD)/n</i> (%)	GDs ( <i>n</i> = 41) <i>M(SD)/n</i> (%)	HCs ( <i>n</i> = 82) <i>M(SD)/n</i> (%)	<i>F/χ</i> <sup>2</sup>
Education						7.91*
High school or less	112 (36.4)	42 (37.5)	32 (43.8)	18 (43.9)	20 (24.4)	
Post-secondary or higher	196 (63.6)	70 (62.5)	41 (56.2)	23 (56.1)	62 (75.6)	
Annual household income						17.87
Under \$20,000	48 (15.6)	17 (15.2)	17 (23.3)	7 (17.7)	7 (8.5)	
\$20,000-\$39,999	77 (25.0)	32 (28.6)	26 (35.6)	10 (24.4)	19 (23.2)	
\$40,000-\$59,999	58 (18.8)	24 (21.4)	10 (13.7)	9 (22.0)	15 (18.3)	
\$60,000-\$79,999	54 (17.5)	17 (15.2)	10 (13.7)	9 (22.0)	18 (22.0)	
\$80,000-\$99,999	25 (8.1)	9 (8.0)	5 (6.8)	2 (4.9)	7 (8.5)	
\$100,000 or higher	38 (12.3)	13 (11.6)	5 (6.8)	4 (9.8)	16 (19.5)	
Marital status						9.29
Single	128 (41.6)	48 (42.9)	36 (49.3)	18 (43.9)	26 (31.7)	
Married/common-law	151 (49.0)	50 (44.6)	30 (41.1)	21 (51.2)	50 (61.0)	
Separated/divorced	29 (9.4)	14 (12.5)	7 (9.6)	2 (4.9)	6 (7.3)	
Past-year substance use						5.76
Yes	41 (13.3)	18 (16.1)	13 (17.8)	5 (12.2)	5 (6.1)	
No	267 (86.7)	94 (83.9)	60 (82.2)	36 (87.8)	77 (93.9)	
DASS-21 Total <sup>e</sup>	29.15 (25.64)	38.02 (24.43)	21.02 (24.33)	39.83 (21.16)	19.93 (24.78)	11.93***
Stress	11.40 (9.29)	13.90 (8.20)	8.91 (9.66)	15.22 (8.45)	8.36 (9.22)	8.45***
Anxiety	7.65 (8.12)	9.88 (7.98)	5.86 (7.66)	10.50 (8.13)	4.88 (7.53)	7.60***
Depression	10.10 (10.51)	14.24 (11.25)	6.25 (8.26)	14.11 (9.34)	6.09 (9.19)	13.60***
Honesty-humility	3.51 (0.69)	3.28 (0.63)	3.65 (0.72)	3.26 (0.62)	3.82 (0.64)	13.88***
Sincerity	3.48 (0.87)	3.29 (0.79)	3.65 (0.88)	3.30 (0.82)	3.67 (0.93)	4.62**

Table 1 Continued

Variable	Total sample ( <i>N</i> = 308) <i>M</i> ( <i>SD</i> )/ <i>n</i> (%)	AUDs ( <i>n</i> = 112) <i>M</i> ( <i>SD</i> )/ <i>n</i> (%)	CUDs ( <i>n</i> = 73) <i>M</i> ( <i>SD</i> )/ <i>n</i> (%)	GDs ( <i>n</i> = 41) <i>M</i> ( <i>SD</i> )/ <i>n</i> (%)	HCs ( <i>n</i> = 82) <i>M</i> ( <i>SD</i> )/ <i>n</i> (%)	<i>F</i> / $\chi^2$
Fairness	3.63 (1.11)	3.27 (1.09)	3.58 (1.04)	3.61 (1.18)	4.16 (0.95)	11.30***
Greed avoidance	3.08 (0.97)	2.84 (0.89)	3.37 (0.94)	2.53 (0.83)	3.44 (0.96)	14.20***
Modesty	3.85 (0.84)	3.72 (0.84)	4.00 (0.80)	3.59 (0.77)	4.01 (0.87)	4.11**
Emotionality	3.31 (0.61)	3.36 (0.59)	3.26 (0.62)	3.50 (0.54)	3.21 (0.66)	2.54
Anxiety	3.58 (0.97)	3.68 (0.96)	3.32 (1.00)	3.78 (0.82)	3.58 (1.01)	2.73*
Fearfulness	3.28 (0.86)	3.36 (0.87)	3.15 (0.82)	3.51 (0.80)	3.18 (0.91)	2.17
Sentimentality	3.48 (0.79)	3.45 (0.74)	3.60 (0.73)	3.67 (0.73)	3.30 (0.89)	2.81*
Dependence	2.92 (0.83)	2.95 (0.77)	2.96 (0.78)	3.05 (0.75)	2.78 (0.98)	1.24
Extraversion	2.99 (0.64)	2.97 (0.68)	3.12 (0.71)	3.06 (0.60)	3.15 (0.77)	1.29
Social self-esteem	3.42 (0.88)	3.23 (0.86)	3.56 (0.86)	3.20 (0.69)	3.66 (0.94)	5.42**
Social boldness	2.72 (0.94)	2.70 (0.96)	2.81 (0.92)	2.77 (0.81)	2.66 (0.99)	0.37
Sociability	2.95 (0.95)	2.91 (0.98)	2.87 (0.94)	3.23 (0.89)	2.93 (0.93)	1.43
Liveliness	3.14 (0.88)	2.99 (0.89)	3.24 (0.90)	3.03 (0.66)	3.33 (0.90)	2.93*
Agreeableness	2.99 (0.64)	2.95 (0.64)	3.00 (0.68)	2.91 (0.54)	3.06 (0.66)	0.70
Forgivingness	2.57 (0.82)	2.62 (0.80)	2.65 (0.80)	2.46 (0.88)	2.48 (0.82)	0.91
Gentleness	3.30 (0.81)	3.23 (0.79)	3.26 (0.83)	3.34 (0.67)	3.41 (0.87)	0.89
Flexibility	2.96 (0.78)	2.90 (0.79)	2.99 (0.76)	2.88 (0.63)	3.05 (0.83)	0.81
Patience	3.13 (0.90)	3.06 (0.90)	3.13 (0.94)	2.95 (0.88)	3.32 (0.84)	2.04
Conscientiousness	3.60 (0.59)	3.38 (0.57)	3.66 (0.57)	3.39 (0.51)	3.87 (0.56)	14.22***
Prudence	3.41 (0.85)	3.14 (0.81)	3.53 (0.84)	3.11 (0.70)	3.80 (0.81)	12.92***
Organization	3.58 (0.84)	3.37 (0.83)	3.63 (0.80)	3.39 (0.78)	3.90 (0.82)	7.59***
Diligence	3.66 (0.79)	3.45 (0.74)	3.75 (0.73)	3.45 (0.74)	3.95 (0.83)	8.17***
Perfectionism	3.67 (0.69)	3.56 (0.66)	3.71 (0.67)	3.60 (0.70)	3.83 (0.71)	2.81*

Table 1 Continued

Variable	Total sample ( <i>N</i> = 308) <i>M</i> ( <i>SD</i> )/ <i>n</i> (%)	AUDs ( <i>n</i> = 112) <i>M</i> ( <i>SD</i> )/ <i>n</i> (%)	CUDs ( <i>n</i> = 73) <i>M</i> ( <i>SD</i> )/ <i>n</i> (%)	GDs ( <i>n</i> = 41) <i>M</i> ( <i>SD</i> )/ <i>n</i> (%)	HCs ( <i>n</i> = 82) <i>M</i> ( <i>SD</i> )/ <i>n</i> (%)	<i>F</i> / $\chi^2$
Openness to experience	3.37 (0.66)	3.27 (0.66)	3.55 (0.67)	3.22 (0.52)	3.41 (0.69)	3.56*
Aesthetic appreciation	3.38 (0.92)	3.18 (0.91)	3.58 (0.92)	3.37 (0.75)	3.48 (0.97)	3.34*
Inquisitiveness	3.43 (0.92)	3.38 (0.89)	3.59 (0.96)	3.14 (0.75)	3.49 (0.99)	2.27
Creativity	3.39 (0.89)	3.27 (0.94)	3.58 (0.86)	3.35 (0.83)	3.42 (0.87)	1.83
Unconventionality	3.26 (0.74)	3.24 (0.75)	3.44 (0.72)	3.04 (0.50)	3.26 (0.82)	2.69*

<sup>a</sup> *N* = 185    AUDs *n* = 112    CUDs *n* = 8    GDs *n* = 4    HCs *n* = 61

<sup>b</sup> *N* = 93    AUDs *n* = 8    CUDs *n* = 73    GDs *n* = 0    HCs *n* = 12

<sup>c</sup> *N* = 84    AUDs *n* = 10    CUDs *n* = 3    GDs *n* = 41    HCs *n* = 30

<sup>d</sup> *N* = 305    AUDs *n* = 111    CUDs *n* = 72    GDs *n* = 41    HCs *n* = 81

<sup>e</sup> *N* = 241    AUDs *n* = 82    CUDs *n* = 57    GDs *n* = 36    HCs *n* = 66

\* *p* < .05

\*\* *p* < .01

\*\*\* *p* < .001

Note: “Not in labour force” includes retired participants, students, homemakers, and participants reporting disability status.

Table 2. Correlations between variables included in main analysis for the total sample ( $N = 308$ ).

	Gender (0 = male)	Age	DASS-S	DASS-A	DASS-D	DASS-T	H	E	X	A	C	O
Age	.09											
DASS-S	.04	-.13*										
DASS-A	-.03	-.16*	.78***									
DASS-D	-.04	-.12	.79***	.71***								
DASS-T	-.01	-.15*	.94***	.89***	.92***							
H	.18**	.36***	-.27***	-.27***	-.28***	-.30***						
E	.41***	.03	.35***	.19**	.27***	.30***	.03					
X	-.04	.11	-.39***	-.27***	-.55***	-.45***	.07	-.24***				
A	-.12*	-.03	-.36***	-.16*	-.32***	-.31***	.29***	-.26***	.31***			
C	.03	.11	-.23***	-.26***	-.35***	-.31***	.44***	-.14*	.27***	.18**		
O	-.07	.04	-.07	-.13*	-.09	-.11	.14*	-.09	.18**	.19**	.34**	

Note: DASS-S = DASS-21 Stress scale; DASS-A = DASS-21 Anxiety scale; DASS-D = DASS-21 Depression scale; DASS-T = DASS-21 Total score; H = HEXACO Honesty-Humility scale; E = HEXACO Emotionality scale; X = HEXACO Extraversion scale; A = HEXACO Agreeableness scale; C = HEXACO Conscientiousness scale; O = HEXACO Openness scale

\*  $p < .05$

\*\*  $p < .01$

\*\*\*  $p < .001$

Table 3. Correlations between variables included in main analysis for AUDs ( $N = 112$ ).

	Gender (0 = male)	Age	DASS-S	DASS-A	DASS-D	DASS-T	H	E	X	A	C	O
Age	.20*											
DASS-S	-.10	-.21										
DASS-A	-.05	-.25*	.70***									
DASS-D	-.08	-.17	.78***	.57***								
DASS-T	-.09	-.23*	.93***	.83***	.91***							
H	.31**	.39***	-.15	-.14	-.09	-.14						
E	.41***	.16	.20	.03	.21	.17	.24*					
X	.03	-.14	-.37**	-.10	-.57***	-.42***	-.14	-.19*				
A	-.11	-.02	-.33**	-.08	-.35**	-.30**	.22*	-.20*	.22*			
C	.04	.13	-.14	-.12	-.17	-.17	.36***	.01	.05	.28**		
O	-.20*	-.09	.08	.02	.11	.09	-.05	-.17	-.07	.15	.11	

Note: DASS-S = DASS-21 Stress scale; DASS-A = DASS-21 Anxiety scale; DASS-D = DASS-21 Depression scale; DASS-T = DASS-21 Total score; H = HEXACO Honesty-Humility scale; E = HEXACO Emotionality scale; X = HEXACO Extraversion scale; A = HEXACO Agreeableness scale; C = HEXACO Conscientiousness scale; O = HEXACO Openness scale

\*  $p < .05$

\*\*  $p < .01$

\*\*\*  $p < .001$

Table 4. Correlations between variables included in main analysis for CUDs ( $N = 73$ ).

	Gender (0 = male)	Age	DASS-S	DASS-A	DASS-D	DASS-T	H	E	X	A	C	O
Age	.03											
DASS-S	.17	-.21										
DASS-A	.11	-.15	.87***									
DASS-D	.10	-.09	.87***	.82***								
DASS-T	.13	-.16	.97***	.94***	.94***							
H	.25*	.48***	-.41**	-.45***	-.39**	-.44**						
E	.37**	-.22	.51***	.36**	.46***	.47***	-.10					
X	-.25*	.19	-.32*	-.22	-.38**	-.33*	.20	-.41***				
A	-.15	-.08	-.33*	-.19	-.37**	-.32*	.20	-.47***	.41***			
C	.06	.14	-.38**	-.41**	-.44**	-.43**	.47***	-.10	.38**	.11		
O	.05	.15	-.09	-.21	-.16	-.16	.41***	.08	.32**	.22	.60***	

Note: DASS-S = DASS-21 Stress scale; DASS-A = DASS-21 Anxiety scale; DASS-D = DASS-21 Depression scale; DASS-T = DASS-21 Total score; H = HEXACO Honesty-Humility scale; E = HEXACO Emotionality scale; X = HEXACO Extraversion scale; A = HEXACO Agreeableness scale; C = HEXACO Conscientiousness scale; O = HEXACO Openness scale

\*  $p < .05$

\*\*  $p < .01$

\*\*\*  $p < .001$

Table 5. Correlations between variables included in main analysis for GDs ( $N = 41$ ).

	Gender (0 = male)	Age	DASS-S	DASS-A	DASS-D	DASS-T	H	E	X	A	C	O
Age	.19											
DASS-S	.31	.14										
DASS-A	-.05	.28	.60***									
DASS-D	-.01	.15	.40*	.51**								
DASS-T	.11	.23	.81***	.85***	.80***							
H	.17	.36*	.14	.08	.02	.10						
E	.42**	.20	.29	-.06	-.08	.06	.35*					
X	.09	.28	.11	-.10	-.55**	-.24	.16	.11				
A	-.39*	.02	-.32	-.04	-.18	-.22	.25	-.19	.23			
C	.30	.08	.36*	-.05	-.26	.01	.29	.34*	.39*	-.02		
O	.19	.23	.25	-.07	.10	.12	-.18	.13	.21	.03	.32*	

Note: DASS-S = DASS-21 Stress scale; DASS-A = DASS-21 Anxiety scale; DASS-D = DASS-21 Depression scale; DASS-T = DASS-21 Total score; H = HEXACO Honesty-Humility scale; E = HEXACO Emotionality scale; X = HEXACO Extraversion scale; A = HEXACO Agreeableness scale; C = HEXACO Conscientiousness scale; O = HEXACO Openness scale

\*  $p < .05$

\*\*  $p < .01$

\*\*\*  $p < .001$

Table 6. Correlations between variables included in main analysis for HCs ( $N = 82$ ).

	Gender (0 = male)	Age	DASS-S	DASS-A	DASS-D	DASS-T	H	E	X	A	C	O
Age	-.08											
DASS-S	-.03	-.11										
DASS-A	-.09	-.28*	.82***									
DASS-D	-.06	-.19	.91***	.87***								
DASS-T	-.06	-.20	.96***	.93***	.97***							
H	-.03	.24*	-.18	-.16	-.21	-.19						
E	.45***	.02	.31*	.24*	.25*	.28*	-.04					
X	-.02	.22	-.61***	-.51***	-.63***	-.61***	.04	-.25*				
A	< .01	-.03	-.38**	-.19	-.28*	-.30*	.44***	-.14	.33**			
C	-.17	-.04	-.15	-.13	-.21	-.18	.28*	-.39***	.35**	.10		
O	-.09	.04	-.12	-.10	-.13	-.12	.07	-.14	.31**	.25*	.35**	

Note: DASS-S = DASS-21 Stress scale; DASS-A = DASS-21 Anxiety scale; DASS-D = DASS-21 Depression scale; DASS-T = DASS-21 Total score; H = HEXACO Honesty-Humility scale; E = HEXACO Emotionality scale; X = HEXACO Extraversion scale; A = HEXACO Agreeableness scale; C = HEXACO Conscientiousness scale; O = HEXACO Openness scale

\*  $p < .05$

\*\*  $p < .01$

\*\*\*  $p < .001$

Table 7. Multinomial logistic regression results among AUDs, CUDs, and GDs by HEXACO personality factors ( $N = 241$ ).

	AUDs vs. HCs		CUDs vs. HCs		GDs vs. HCs	
	Adjusted OR	95% CI	Adjusted OR	95% CI	Adjusted OR	95% CI
Gender (male)	1.42	0.63-3.19	1.11	0.49-2.52	0.61	0.22-1.71
Age	1.00	0.97-1.04	0.96*	0.92-0.99	1.03	0.99-1.08
DASS-T	1.03**	1.01-1.05	1.00	0.98-1.03	1.04***	1.02-1.06
H	0.46*	0.22-0.96	1.70	0.90-3.62	0.31*	0.13-0.78
E	1.88	0.84-4.21	0.80	0.37-1.73	1.52	0.58-3.99
X	1.32	0.70-2.49	1.44	0.77-2.71	1.85	0.84-4.08
A	1.44	0.73-2.86	0.59	0.29-1.17	1.53	0.66-3.53
C	0.26**	0.11-0.61	0.46	0.20-1.06	0.42	0.15-1.17
O	1.00	0.53-1.87	2.13*	1.10-4.13	0.65	0.30-1.40

\*  $p < .05$

\*\*  $p < .01$

\*\*\*  $p < .001$

Table 8. Multinomial logistic regression results among AUDs and GDs by HEXACO honesty-humility facets ( $N = 184$ ).

	AUDs vs. HCs		GDs vs. HCs	
	Adjusted OR	95% CI	Adjusted OR	95% CI
Gender (male)	0.93	0.42-2.02	2.16	0.74-6.30
Age	1.01	0.98-1.04	1.03	0.99-1.08
DASS-T	1.03**	1.01-1.05	1.04***	1.02-1.06
Sincerity	1.23	0.71-2.13	1.38	0.67-2.86
Fairness	0.54**	0.34-0.85	0.64	0.36-1.14
Greed avoidance	0.58*	0.37-0.90	0.34**	0.18-0.65
Modesty	0.91	0.53-1.57	0.83	0.40-1.70

\*  $p < .05$

\*\*  $p < .01$

\*\*\*  $p < .001$

Table 9. Binary logistic regression results among AUDs by HEXACO conscientiousness facets ( $N = 148$ ).

	AUDs vs. HCs	
	Adjusted OR	95% CI
Gender (male)	0.73	0.33-1.57
Age	1.00	0.97-1.03
DASS-T	1.03**	1.01-1.05
Organization	0.85	0.49-1.46
Diligence	0.86	0.48-1.52
Perfectionism	1.11	0.56-2.23
Prudence	0.36**	0.20-0.66

\*\*  $p < .01$

Table 10. Binary logistic regression results among CUDs by HEXACO openness facets ( $N = 123$ ).

	CUDs vs. HCs	
	Adjusted OR	95% CI
Gender (male)	0.97	0.43-2.20
Age	0.97*	0.94-1.00
DASS-T	1.00	0.99-1.02
Aesthetic appreciation	0.65	0.37-1.13
Inquisitiveness	1.16	0.69-1.97
Creativity	2.12*	1.20-3.76
Unconventionality	1.37	0.69-2.74

\*  $p < .05$

Table 11. MANCOVA results of HEXACO personality traits by addictive behaviour group ( $N = 226$ ).

	Group $M(SD)$			$p$
	AUDs ( $N = 112$ )	CUDs ( $N = 73$ )	GDs ( $N = 41$ )	
H	3.31 (0.66) <sup>a</sup>	3.77 (0.67) <sup>b</sup>	3.32 (0.62) <sup>a</sup>	< .001
E	3.44 (0.56)	3.25 (0.61)	3.47 (0.53)	.499
X	2.92 (0.72)	3.20 (0.70)	3.07 (0.59)	.404
A	2.91 (0.59)	3.01 (0.73)	2.91 (0.56)	.860
C	3.34 (0.57) <sup>a</sup>	3.74 (0.54) <sup>b</sup>	3.44 (0.51) <sup>a</sup>	.006
O	3.26 (0.66) <sup>a</sup>	3.64 (0.63) <sup>b</sup>	3.18 (0.51) <sup>a</sup>	.001

Note: Cells with different superscripts significantly differ from one another. Analysis included participant gender, age, and DASS-21 score as covariates.

Table 12. Multinomial logistic regression results among AUDs and GDs against CUDs by HEXACO honesty-humility facets ( $N = 175$ ).

	AUDs vs. CUDs		GDs vs. CUDs	
	Adjusted OR	95% CI	Adjusted OR	95% CI
Gender (male)	0.97	0.43-2.20	0.45	0.16-1.30
Age	1.04*	1.00-1.08	1.07**	1.02-1.13
DASS-T	1.03**	1.01-1.05	1.04**	1.02-1.06
Sincerity	0.58*	0.34-0.99	0.61	0.30-1.24
Fairness	1.23	0.79-1.91	1.79*	1.02-3.16
Greed avoidance	0.55*	0.33-0.92	0.34**	0.18-0.65
Modesty	0.64	0.36-1.14	0.44*	0.21-0.91

\*  $p < .05$

\*\*  $p < .01$

Table 13. Multinomial logistic regression results among AUDs and GDs against CUDs by HEXACO conscientiousness facets ( $N = 175$ ).

	AUDs vs. CUDs		GDs vs. CUDs	
	Adjusted OR	95% CI	Adjusted OR	95% CI
Gender (male)	1.63	0.74-3.57	0.75	0.28-2.01
Age	1.02	0.98-1.05	1.04	1.00-1.08
DASS-T	1.03**	1.01-1.05	1.04	1.01-1.06
Organization	1.28	0.72-2.29	1.20	0.61-2.36
Diligence	0.55	0.29-1.05	0.67	0.31-1.42
Perfectionism	0.87	0.43-1.73	0.73	0.32-1.64
Prudence	0.52*	0.29-0.92	0.69	0.35-1.37

\*  $p < .05$

\*\*  $p < .01$

Table 14. Multinomial logistic regression results among AUDs and GDs against CUDs by HEXACO openness facets ( $N = 175$ ).

	AUDs vs. CUDs		GDs vs. CUDs	
	Adjusted OR	95% CI	Adjusted OR	95% CI
Gender (male)	1.47	0.67-3.26	0.81	0.30-2.21
Age	1.02	0.98-1.05	1.03	0.99-1.08
DASS-T	1.04***	1.02-1.05	1.04***	1.02-1.06
Aesthetic appreciation	0.71	0.42-1.20	1.06	0.55-2.03
Inquisitiveness	1.01	0.59-1.76	0.84	0.44-1.62
Creativity	0.53*	0.30-0.93	0.73	0.38-1.42
Unconventionality	0.85	0.40-1.82	0.36*	0.14-0.90

\*  $p < .05$

\*\*  $p < .01$

\*\*\*  $p < .001$

