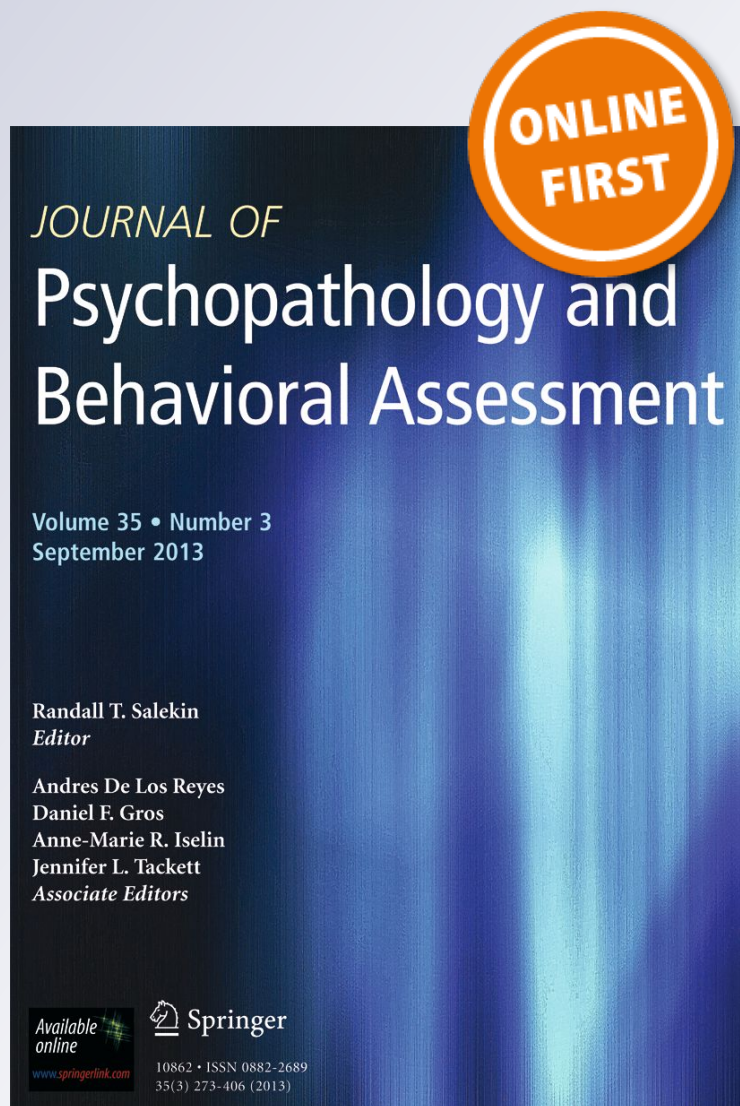*The Personality Context of Adolescent Gambling: Better Explained by the Big Five or Sensation-Seeking?*

Kathleen W. Reardon, Meggie Wang, Clayton Neighbors & Jennifer L. Tackett

ONLINE
FIRST

Springer

Springer

CrossMark

The Personality Context of Adolescent Gambling: Better Explained by the Big Five or Sensation-Seeking?

Kathleen W. Reardon[1] · Meggie Wang[1] · Clayton Neighbors[2] · Jennifer L. Tackett[1]

Abstract

Adolescent gambling is a serious and increasingly common problem. Studies in adults have found several within- and between-person associations between personality and gambling. We aim to extend these findings to a sample of adolescents selected for gambling behavior. Participants consisted of a racially diverse sample of adolescents between the ages of 13 and 17 ($n = 227$). We collected self-reported information on normal-range personality traits, sensation-seeking, and gambling frequency, severity, and motives in an online survey. Normal-range personality traits were not correlated with gambling, but trait sensation-seeking was positively correlated with gambling. Latent class analyses showed that classes of adolescent gamblers may be differentiated based on personality trait patterns, although these classes were not differentiated on gambling severity or frequency. Finally, in hierarchical analyses, six homogenous components representing the five normal-range personality traits and sensation-seeking accounted for maximum variance in gambling outcomes. In this model, components representing sensation-seeking and conscientiousness were the only significant unique predictors of gambling-related outcomes. Our findings suggest that subgroups of adolescent gamblers may be distinguished based on personality trait patterns before the emergence of problematic gambling. In other words, personality differences may reflect an early predisposition to divergent pathways to adolescent gambling. Our findings concur with previous work and underscore the importance of sensation-seeking as a particularly important risk factor of initiation and escalation of adolescent gambling.

Keywords Gambling · Adolescents · Personality · Sensation-seeking · Gambling motives · Gambling severity

Prevalence rates of any gambling, at-risk gambling, and problem gambling are higher among adolescents than any other age group, including young adults and college students

✉ Kathleen W. Reardon
  kwreardon@u.northwestern.edu

  Meggie Wang
  meggiewang2017@u.northwestern.edu

  Clayton Neighbors
  cneighbo@central.uh.edu

  Jennifer L. Tackett
  jennifer.tackett@northwestern.edu

[1] Department of Psychology, Northwestern University, Swift Hall, 2029 Sheridan Road, Evanston, IL 60208, USA

[2] Department of Psychology, University of Houston, 3695 Cullen Blvd, Rm 126, Houston, TX 77204, USA

(Blinn-Pike et al. 2010). Despite legal restrictions on underage gambling in many countries, including the United States, teenagers are increasingly gaining access to means of gambling through the Internet and through a proliferation of games and apps that closely approximate gambling behaviors (i.e., risking something of value for a potential gain; Griffiths and Parke 2010; D. L. King et al. 2014). Under-age adolescents frequently report gambling on racing or sports (24%), lottery tickets (23%), and poker machines or video games (13%; Jackson et al. 2008). Prevalence estimates of under-age gambling vary considerably (Derevensky et al. 2003; Shaffer and Korn 2002), yet it is clear that adolescent problem gambling represents a significant public health and social policy issue.

Indeed, adolescent gambling behavior has only started to gain attention from a public health standpoint, incorporating questions about the role of community factors, norms, socio-economic variables, and the role of the media in the past couple of decades (Korn and Shaffer 1999; Messerlian 2005). Gambling disorder in adults is associated with deleterious consequences including financial problems, academic impairment,

social conflict, psychological distress, risk for suicide attempts and completion, and relationship difficulties (Blinn-Pike et al. 2010; Delfabbro et al. 2006; Derevensky and Gupta 2000; Neighbors et al. 2002; Weinstock et al. 2008). For a review of prevalence rates and mental health disorders frequently comorbid with gambling problems, see Shaffer and Korn (2002) and Richard and Derevensky (2017). Adult gambling problems are robustly predicted by patterns of childhood and adolescent gambling (Carbonneau et al. 2015; Derevensky et al. 2003). Thus, more research is needed to better identify early pathways to these problematic outcomes (Blinn-Pike 2017).

A large body of research examining reward processing from a neural standpoint has established that adolescence is a particularly critical time for brain development (Braams et al. 2015). Further, studies have shown that hypersensitivity of reward circuitry in healthy adolescents is context-specific and highly sensitive to social cues (Braams et al. 2014). Relatedly, concerns about the problematic use of smartphone techonologies and discussions of "addiction" have recently received much research and popular press attention (Veissière and Stendel 2018), giving voice to the concern that changing youth's interactions with and access to rewarding stimuli (such as winning money in gambling) will produce profound and longstanding changes in neural circuitry. For these reasons, increased access to online gambling and gambling-like activities for adolescents and even young children may represent especially worrisome possibilities. Thus, thoroughly understanding the correlates of adolescent gambling behavior is critical. The present study aims to examine early personality indicators of gambling behavior in an adolescent cohort selected for engagement in some gambling behaviors.

Personality and Gambling

Personality traits reflect individual differences in thoughts, feelings, and actions, and are associated with many forms of undercontrolled psychopathology, including problematic gambling (Bagby et al. 2007; S. M. King et al. 2010; MacLaren et al. 2011; Miller et al. 2013). In general, gambling behaviors have been associated with risk-taking, impulsivity, and sensation-seeking traits (Bagby et al. 2007; MacLaren et al. 2011; Slutske et al. 2005). Sensation-seeking in particular has been positively related to gambling frequency in undergraduate students (Smith et al. 2007), to gambling in an Italian sample of high school students (Primi et al. 2011), and to online gaming addiction in a Chinese sample of adolescents (Hu et al. 2017). A recent meta-analysis found moderate support for sensation-seeking, impulsivity, and uncontrolled temperament as predictors of later gambling behaviors (Dowling et al. 2017)

In addition to impulsivity and related traits, some research has focused on broader personality traits, including those in the Five Factor Model (FFM; Costa & McCrae 1992). As with other forms of externalizing psychopathology, the typical trait profile for adult pathological gamblers reflects high neuroticism (or negative affectivity), low agreeableness (or interpersonal compassion and politeness), and low conscientiousness (or self-regulation and self-control; Bagby et al. 2007; Brunborg et al. 2016; MacLaren et al. 2011; Miller et al. 2013; Slutske et al. 2005; Tackett et al. 2015). Another approach in adults has examined subgroups of gamblers as defined by patterns of personality traits in person-centered analyses. One study found evidence for four groups differentiated by gambling severity and personality (Vachon and Bagby 2009). Classes of pathological gamblers were differentiated from one another such that "hedonic" gamblers scored highest on extraversion and openness, and "demoralized" gamblers scored highest on neuroticism. A study in college students found evidence for three groups differentiated by personality patterns, such that "resilient" gamblers scored highest on extraversion, openness, and self-control, and "vulnerable" gamblers scored lowest on these same traits (Tackett et al. 2015). There also exists evidence for five classes in a small sample of adolescent problem gamblers ($n = 109$; Gupta et al. 2013), differentiated from one another by risk factors and varying profiles of comorbidity. The present study examines the potential for extending the approach of personality-based classes of gamblers to a larger, racially-diverse sample of community adolescents selected for their participation in gambling behaviors.

There has been much work examining the relationship between impulsivity and related traits such as sensation-seeking to the Big Five. Sensation-seeking represents a narrower instantiation of trait extraversion, which is a trait not typically found to be associated with gambling, although there is some evidence that sensation-seeking fits into the space between traits (Zuckerman and Glicksohn 2016). In particular, it has been argued that, because of gambling's associations with high neurticism and low conscientiousness, using the context of the UPPS (Urgency, Planning/Persistance, Sensation-seeking) model of impulsivity (Whiteside and Lynam 2001) is superior to the Big Five Model of personality (Canale et al. 2017). Importantly, an empirical comparison between sensation-seeking and the Big Five model of personality in predicting genetic variance in antisocial behavior in a large sample of twins indicated that sensation-seeking outperformed other personality traits (Mann et al. 2017). Despite the theoretical argument that a model of impulsivity is more appropriate than the Big Five for understanding gambling (Canale et al. 2017), no work to date has provided empirical support for this question of which model is more useful for understanding gambling behaviors in adolescents.

Personality and Gambling Motives

A three-factor model of motives for gambling has been proposed by Stewart and Zack (2008), and although there are

other models, this one has attracted the most research attention to date. The three motives are defined as "Coping", which is related to relieving negative affect, "Enhancement", which is related to strengthening positive affect, and "Social", which is related to strengthening social connections.

These motives have been connected to the Big Five model of personality, as well. Tackett et al. (2015) reported that low agreeableness and high neuroticism were associated with coping motives, MacLaren et al. (2015) demonstrated that coping motives moderated the relationships between conscientiousness and gambling severity, and McGrath et al. (2018) demonstrated moderation by motives of the relationship between gambling and HEXACO honesty-humility, agreeableness, and conscientiousness. Finally, in a longitudinal investigation, extraversion was associated with enhancement and social motives and agreeableness was related to social and coping motives in young adults (Mackinnon et al. 2016). Despite these connections in young adult and older samples, no work to date has investigated how gambling motives may fit into the landscape of personality, sensation-seeking, and gambling problems in adolescents.

Hierarchical Models of Personality

Additionally, personality traits are organized hierarchically (Markon et al. 2005), and it has been shown that higher-order levels of the hierarchy are useful for providing additional information about boundaries and severity of psychopathology (Kushner et al. 2011; Tackett et al. 2008a). Psychopathology can also be organized and understood hierarchically, which helps to explain phenotypic comorbidity among disorders (Forbes et al. 2016; Kim and Eaton 2015). These studies demonstrate the applicability of hierarchical models of personality to areas where delineation of subgroups may otherwise be unclear. It has repeatedly been shown that understanding the hierarchical structure of broad dimensions of personality that span both normative and pathological domains can provide scaffolding to organize the understanding of psychopathology more broadly (Wright et al. 2012; Wright and Simms 2014). The specific level of the personality hierarchy providing the most explanatory power may differ by group and by specific diagnosis (Hopwood et al. 2015; Kushner et al. 2011); thus, the present study aimed to determine which level of the personality hierarchy is most useful for predicting gambling severity, as well as frequency and motives, in adolescence.

The Present Study

The primary goal of the present study was to examine associations between personality and gambling behavior in a sample of adolescents, an under-represented population in the broader literature. As this is a descriptive study with the primary aim of providing information about the state of relationships between Big Five personality, sensation-seeking, and gambling whatever they may be, we did not have specific, directional hypotheses. We approached this goal in several ways: 1) we examined the correlations between gambling behaviors and personality measures in adolescents, 2a) we took a person-centered, latent class approach to understanding potential subgroups differentiated by personality traits, 2b) we examined whether class membership predicts differences in gambling severity or gambling motives, and 3) we examined which level of the personality hierarchy is most powerful for the prediction of gambling severity, frequency, and motives in the context of adolescence.

Methods

Participants

Self-report data were collected from 227 adolescents (51.3% female) between the ages of 13 and 17 ($M = 15.41$, $SD = 1.08$). Caregivers provided consent before online questionnaires were sent to the adolescent. Adolescents reported on their race/ethnicity: 33.0% identified as White, 27.8% as Latino or Latina, 18.5% as Black, 9.6% as Asian, and 7.9% as Other; 3.2% of participants refused to provide their race/ethnicity. Although this sample is quite diverse, participants were not selected on race/ethnicity in any way. Indeed, this breakdown is generally representative of the urban area from which the sample was recruited, which has a population that is 25.8% White, 43.1% Hispanic, 23.5% Black, and 6.2% Asian. Adolescents also reported on their family financial status: 41.4% responded "well-off financially," 47.2% responded "sufficient to fulfill basic needs," 6.2% responded "poor," and 0.4% responded "very poor"; 4.8% of participants refused to provide their family financial status. Adolescents were recruited through targeted online advertising on social media sites and competitive gaming and sport forums, as well as locally through school- and community-based recruitment. Participants were screened before being sent questionnaires. The inclusion criteria were fluency in English and participation in gaming or gambling behaviors within the past year.[1] The exclusion criteria were learning disabilities or psychological disorders that would prevent adolescents from filling out online questionnaires.

---

[1] During screening, potential participants were asked about the following gaming/gambling behaviors: Used poker applications on social networking sites such as Facebook or Bebo?; Played games for virtual money on virtual pet sites such as Fluffy Friends, NeoPets, FooMojo, or FooPets, or Webkinz!?; Played "free-play"/"demo"/"money-free" games on Internet gambling sites?; Placed bets on a videogame or arcade game?; Placed bets on the Internet, e.g., sports bets (Fantasy Football, March Madness, Super Bowl squares,etc.)?; Bought a lottery ticket/scratch card?; Played dice/craps for money or something of value?; Gambled on a slot or poker machine?; Placed bets with a bookie?

Measures

Individual Differences

Big five Inventory (BFI; (John et al. 1991) The BFI is a 44-item questionnaire which measures Openness (O; 10 items), Conscientiousness (C; 9 items), Extraversion (E; 8 items), Agreeableness (A; 9 items), and Neuroticism (N; 8 items). Items were rated on a five-point scale ranging from 1 (*Disagree Strongly*) to 5 (*Agree Strongly*). The five traits had coefficient alphas ranging from .70 to .80 (average $\alpha = .74$) in the present sample.

Brief Sensation Seeking Scale (BSSS; (Hoyle et al. 2002) The BSSS is an 8-item questionnaire adapted from Form V of the Sensation Seeking Scale with four subscales (2 items each): Experience Seeking, Thrill Seeking, Disinhibition, and Boredom (Zuckerman et al. 1978). The eight items are combined to create a total sensation-seeking (SS) score. Items were rated on a five-point Likert scale ranging from 1 (*Disagree Strongly)* to 5 (*Agree Strongly)*. The total SS scale had a coefficient alpha of .79 in the present sample.

Gambling Behaviors

Canadian Adolescent Gambling Inventory (CAGI; (Tremblay et al. 2010) The CAGI is a 44-item questionnaire which measures the frequency of types of gambling activities and the severity of consequences associated with gambling behavior in adolescents (Tremblay et al. 2010). The present study focused on the Global Problems Severity Subscale (GPSS; 9 items) as well as the 19 items that assess gambling frequency. Items on the GPSS were rated on a four-point Likert scale ranging from 1 (*Never*) to 4 (*Almost Always*); frequency items were rated on a 6-point scale ranging from 1 (*Not in the past 3 months*) to 6 (*Daily*). The GPSS had a coefficient alpha of .72 in the present sample.

The DSM-IV-Multiple Response-Juvenile Criteria to Identify Adolescent Problem Gambling (DSM-IV-MR-J; (Fisher 2000) The DSM-IV-MR-J is a 9-item symptom checklist reflecting the DSM-IV criteria in adolescents. The nine items are summed to create a total DSM-IV-MR-J score. Items were rated on a 4-point scale ranging from 1 (*Never*) to 4 (*Often*). The DSM-IV-MR-J had a coefficient alpha of .86 in the present sample.

Gambling Motives Questionnaire (GMQ; (Stewart and Zack 2008) The GMQ is a 15 item measure modeled after the Drinking Motives Questionnaire (Cooper et al. 1992) which measures gambling-specific motives. The three subscales (5 items each) include Enhancement Motives, Coping Motives, and Social Motives. Items were rated on a 6-point scale ranging from 1 (*Almost Never/Never*) to 6 (*Daily*). The subscales had the following coefficient alphas in the present sample: Enhancement Motives = .86, Coping Motives = .84, and Social Motives = .83.

Procedure

Parental consent was required for the adolescents to participate, and consent was submitted either online or through postal mail. Adolescent participants filled out an online assent form before filling out questionnaires through Qualtrics, an online survey platform. Adolescents were compensated with a $30 gift card. The study methods and materials were approved by the Research Ethics boards at the relevant institutions. Missing data were present in this sample because some participants discontinued before they had reached the end of the survey. Specifically, no participants were missing the BFI, one participant was missing the BSSS (0.4%), 11 participants were missing the GPSS (4.8%), 12 participants were missing the DSM-IV-MR-J (5.3%), and 13 participants were missing the GMQ (5.7%). However, data were missing completely at random (Little's MCAR X^2 (45) = 43.00, $p = .557$).

Results

Sample Descriptives

All participants in the sample were selected for having endorsed some form of gambling in the past 12 months; 37% endorsed some form of gambling within the last 3 months. The following items were endorsed most frequently (at least once per month within the last three months): 36.87% of the sample endorsed having gambled on *a dare or challenge that you or someone else could do something*, 24.65% of the sample endorsed having gambled on *your or someone else's performance on games of skill*, and 20.6% of the sample endorsed having gambled on *arcade or video games*. Five or more DSM-IV criteria (the symptom threshold for diagnosis) were endorsed by 9.2% of the sample. Full sample descriptives can be found in Supplemental Table 1.

To understand whether the present sample, selected for gambling behavior, was different from the general population in terms of personality, a comparison sample was needed. To examine age-related changes in personality, Soto et al. (2011) collected an extremely large cross-sectional Internet sample ($n = 1,267,218$) over a period of seven years. Participants were not screened on or selected for any particular variables, and were diverse in terms of race/ethnicity and SES; 72% of the sample resided in the United States (Soto et al. 2011). For these reasons, we expected that this would make a reasonably good population-representative comparison sample on personality variables. Data on the Big Five Inventory from all

participants between the ages of 13 and 17 were shared with us by the study's first author, resulting in a subset of 255,986 adolescents. Because of the extreme difference in sample sizes, a Welch's T test was performed to account for unequal variances. Some differences between the two samples were observed, with the present sample scoring higher on E ($t(226) = 2.15$, $p = .033$), higher on A ($t(226) = 3.63$, $p < .001$), higher on C ($t(226) = 6.23$, $p < .001$), and lower on N ($t(226) = 3.81$, $p < .001$). The two samples did not differ on O ($t(226) = 1.92$, $p = .057$). Full information on trait comparisons can be found in Supplemental Table 2.

Personality, Gambling Severity, and Motives

Aggregate gambling severity was modeled in a one-factor confirmatory factor analysis (CFA) in MPLUS 7.0. Sets of items from the CAGI and DSM-IV-MR-J were aggregated into 12 parcels[2] which were modeled as the indicators of the latent factor in the CFA. Correlations were estimated between the gambling severity factor score, gambling motives, and personality traits (Table 1). Gambling severity was positively correlated with SS, enhancement motives, and coping motives. Social motives were positively correlated with E, and coping motives were positively correlated with O. FFM traits were not significantly correlated with gambling severity.

Latent Class Analyses

Latent class analyses were conducted in MPLUS 7.0, based on within-person covariation in the six personality traits measured: N, E, A, C, O, and SS. The Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) are goodness-of-fit measures used to compare models; lower observed values indicate better fit. Entropy indicates greater classification certainty and ranges from 0 to 1, with higher values indicating more certainty in classification. These statistical indicators were combined with conceptual analysis of model results to determine the most desirable model.

Based on previous models identified in the literature (Goldstein et al. 2013; Tackett et al. 2015; Vachon and Bagby 2009) we extracted 2-, 3-, and 4-class models (Table 2). AIC and entropy favored a 4-class model, but this model included one class with a very small sample size ($n = 2$), so this model was rejected. Between the 2- and 3-class models, AIC favored the 3-class model, and as this was consistent with previous work in this area, the 3-class model was examined in further analyses. However, entropy for all models was lower than is ideal, so classes should be interpreted tentatively.

Personality and gambling scores for each class are presented in Table 3. Classes were labeled based on their personality

profile (see Fig. 1). Members of class 1 ($n = 42$), labeled "controlled" adolescent gamblers, have the lowest scores on both E and SS, as well as the highest scores on A and C, with average scores on O and relatively low N. Members of class 2 ($n = 73$), referred to as "reward-sensitive" adolescent gamblers, have the highest scores on both E and SS, and the lowest scores on N, with moderate scores on self-regulatory traits (A and C). Members of class 3 ($n = 112$), referred to as "vulnerable" adolescent gamblers, have the highest scores on N, low scores on those traits associated with resiliency (E, A, C), and moderate scores on O and SS. The trait profiles for the three classes are illustrated in Fig. 1.

Class membership did not differ significantly by age ($\chi^2(8) = 10.65$, $p = .222$), gender ($\chi^2(2) = 3.77$, $p = .152$), or race ($\chi^2(18) = 17.06$, $p = .519$), so no covariates were included in the remaining analyses. A series of univariate generalized linear models (GLM) was used to examine evidence for class differences. Gambling severity, frequency and coping motives did not differ significantly across classes. However, enhancement ($F = 3.73$, $p = .026$) and social ($F = 5.76$, $p = .004$) motives differed significantly across all three classes such that reward-sensitive gamblers were highest relative to the other two classes (Table 3). Exploratory post-hoc analyses were conducted to examine potential 2-class differences where no 3-class differences were found. In these analyses, lower CAGI severity and frequency scores differentiated controlled gamblers from reward-sensitive gamblers, but did not differentiate vulnerable gamblers from either group (Table 3).

Hierarchical Analyses

Following Goldberg's (2006) "bass-ackwards" method, we next examined the hierarchical structure of individual differences in this selected sample of adolescent gamblers. This was to determine whether higher-order levels of the personality hierarchy provide additional information in predicting gambling severity. The 44 items of the BFI and the 8 items of the BSSS were together subjected to principal components analyses. First, one unrotated principal component was extracted. Next, varimax rotation was applied, and 2 through 6 factors were extracted. The regression-based factor scores at each level were saved and then correlated, which provides path estimates between factors from one level of the hierarchy to the next. Figure 2 shows the six levels of the hierarchy and their intercorrelations. Items with a loading of .40 or greater were considered in determining the content of each component. Complete factor loadings are available on the Open Science Framework: https://osf.io/dywg5/?view_only= 383329c9a7554b8ab4cca1b9c24baf1f.

At Level 2, there were two components, labeled Approach (high loadings from E, O, and SS), and Avoidance (high loadings from N, A (reversed), and C (reversed)). At Level 3, Approach split into two components labeled Reward (high

---

[2] 3 parcels for 9 items of the GPSS from the CAGI; 6 parcels for 19 frequency items from the CAGI; 3 parcels for 9 items of the DSM-IV-MR-J

Table 1 Correlations between gambling severity, motives, and personality variables

	M (SD)	E r	A r	C r	N r	O r	SS r
Gambling							
Aggregate Severity	0.00 (0.62)	.09	−.07	−.12	−.10	.10	.21**
Motives							
Enhance	1.27 (0.47)	.12	.04	−.09	−.10	.13	.26***
Social	1.19 (0.39)	.15*	.03	−.07	−.13	.12	.27***
Coping	1.15 (0.34)	.04	.02	−.07	−.12	.15*	.12

Aggregate Severity score = regression-based factor scores derived through Confirmatory Factor Analysis from the Canadian Adolescent Gambling Inventory (CAGI) severity and frequency items and the DSM-IV-MR-J items; *E* extraversion, *A* agreeableness, *C* conscientiousness, *N* neuroticism, *O* openness to experience, *SS* sensation seeking, *Enhance* enhancement motives; *p < .05. **p < .01. ***p < .001

loadings from E and SS) and Adaptability (high loadings from A, O, and C). Level 2 Avoidance was preserved at Level 3. At Level 4, Adaptability and Avoidance from Level 3 were preserved, and Reward split into two factors, one defined by SS, and one defined by E. At Level 5, SS, E, A, and O all emerge as separate components. The remaining factor comprises N and C (reversed). Finally, at Level 6, six homogenous components emerge (N, O, SS, E, A, and C (reversed)). Full descriptions of the content of the factors can be found in the Appendix.

Multiple regression analyses were then conducted using factor scores at each level of the personality hierarchy to predict gambling severity, frequency, and motives (Table 4). Those components containing SS items (i.e., Approach at Level 2, Reward at Level 3, and SS at Levels 4, 5, and 6) significantly predicted Aggregate Gambling Severity, CAGI Frequency, and both enhancement and coping motives at all levels of the hierarchy (i.e., levels 1–6). The SS component at Levels 4–6 significantly predicted gambling in the past three months, and at Level 4 the SS component predicted coping motives. The C (reversed) component at Level 6 significantly predicted Aggregate Severity as well as enhancement and

coping motives. This C (reversed) component contains unique information only once it becomes differentiated from A, at Level 6. Based on these analyses, Level 6 of the hierarchy, containing homogenous components for each of the FFM traits and SS separately, may be the most useful level of analysis for explaining variance in variables related to adolescent gambling.

Discussion

In this group of adolescents selected for gambling participation, gambling behaviors were positively correlated with trait SS but not with any of the FFM personality traits, in contrast to common findings in adults (MacLaren et al. 2011; Miller et al. 2013; Tackett et al. 2015). This is in line with findings from other forms of externalizing problems (e.g., antisocial behavior), that SS holds more explanatory power than the Big Five traits (Mann et al. 2017).

Nonetheless, the present study also demonstrated meaningful subgroups of adolescents who gamble as defined by clusters of personality traits. Specifically, evidence supported a 3-class solution, differentiating (1) a *vulnerable* group, with the highest level of N and lowest levels of self-regulatory traits; (2) a *reward-sensitive* group, with high levels of E and SS and the lowest levels of N; and (3) a *controlled* group, with the highest levels of C and A, and the lowest levels of E and SS. These personality profiles are similar to those in emerging adults (i.e., college students; Tackett et al. 2015), with the exception of the controlled gamblers in this adolescent sample. The vulnerable class of adolescent gamblers displayed the established pattern of personality traits associated with problem gambling (i.e., low C and A, and high N), and this may be the group most likely to go on to develop gambling-related problems later in life. Notably, the vulnerable subgroup also represents the largest class in this sample specifically selected for previous gambling behavior. Unlike previous research in adults finding "hedonic" and "demoralized" classes that

Table 2 Statistical fit indices from latent class analyses

	2-Class model	3-Class model	4-Class Model
Statistical fit indices			
AIC	3827.95	3820.63	3811.44
BIC	3893.02	3909.68	3924.46
Entropy	0.568	0.553	0.659
Class size			
Class 1	96	42	2
Class 2	131	73	46
Class 3		112	116
Class 4			63

AIC akaike's information criterion, *BIC* bayesian information criterion

Table 3 3 Class solution profile: age, gender, personality trait scores, gambling hehaviors, and gambling motives by personality class

	Class 1 (*n* = 42) Controlled *M(SD)*	Class 2 (*n* = 73) Reward-Sensitive *M(SD)*	Class 3 (*n* = 112) Vulnerable *M(SD)*	Pairwise comparisons		
				1 versus 2	2 versus 3	1 versus 3
Age	15.24(1.03)	15.61(1.16)	15.34(1.04)			
p				.075	.096	.604
Gender (% female)	60%	42%	54%			
p				.079	.124	.552
Individual differences						
Extraversion	3.07(0.53)	3.96(0.58)	3.20(0.63)			
Agreeableness	4.140(0.39)	3.85(0.54)	3.41(0.52)			
Conscientiousness	3.87(0.44)	3.69(0.49)	3.07(0.45)			
Neuroticism	2.52(0.57)	2.36(0.55)	3.30(0.64)			
Openness	3.50(0.48)	3.80(0.52)	3.53(0.57)			
Sensation Seeking	19.48(5.58)	31.01(4.48)	26.01(5.76)			
Gambling outcomes						
CAGI GPSS	8.98(2.31)	9.94(2.34)	9.46(2.46)			
p				.041	.193	.273
DSM-IV-MR-J	9.83(2.00)	10.70(3.17)	10.43(3.41)			
p				.158	.586	.293
CAGI Frequency	20.64(3.80)	23.25(5.74)	22.28(5.94)			
p				.016	.253	.105
Motives						
Enhancement	1.19(0.37)	1.40(0.57)	1.23(0.42)			
p				.022	.018	.666
Coping	1.10(0.23)	1.31(0.48)	1.15(0.35)			
P				.533	.466	.962
Social	1.14(0.32)	1.18(0.35)	1.14(0.34)			
p				.003	.004	.464

mapped neatly onto Cooper et al.'s (2008) model of enhancement and coping motives, respectively (Vachon and Bagby 2009), in the present study, only the reward-sensitive class was distinguished by higher enhancement and social motives. No variables distinguished the controlled from the vulnerable class. Importantly, there were no significant differences across all three classes in gambling severity or frequency. These results underline the importance of including measures of personality in studies about adolescent gambling – although only suggestive, these findings point to the possibility that personality traits differentiate types of adolescent gamblers even when observed gambling behaviors do not.

Next, to understand the predictive power of higher-order levels of the hierarchy, the present study investigated the structure of personality in adolescent gamblers. The resulting hierarchy looks quite similar to previous models in youth (Tackett et al. 2012) and adults (Markon et al. 2005), with, at the two-factor level, one higher-order factor representing Approach (E, O, and SS), and the other representing Avoidance (C, A, and N). Unlike previous work using the hierarchy to predict

outcomes (Kushner et al. 2011; Tackett et al. 2008b), very few components provided predictive power with respect to gambling variables. In fact, only those components containing variance from SS and C were predictive of any of the variables of interest, and the analyses suggested that Level 6, containing discrete components for each of the FFM traits and SS, was the most useful level of analysis. Thus, the higher-order levels of the hierarchy do not provide important predictive power for gambling severity. The levels of the hierarchy did a particularly poor job accounting for variance in coping motives; this is in line with previous work that has suggested that a clear coping pathway may emerge later in development, and would not be readily detected in a sample of adolescents (Cooper et al. 2008; Tackett et al. 2015; Vachon and Bagby 2009). The results of the present study further suggest that SS is not redundant with the information provided by the FFM, but rather complementary. The results from both the correlational analyses and the hierarchical structure analyses suggest that including a measure of SS, in addition to broad personality, is prudent in the context of adolescent gambling behaviors.

Fig. 1 Big Five and Sensation-Seeking scores resulting from the three-class solution of a personality-based latent class analysis of a selected sample of adolescent gamblers
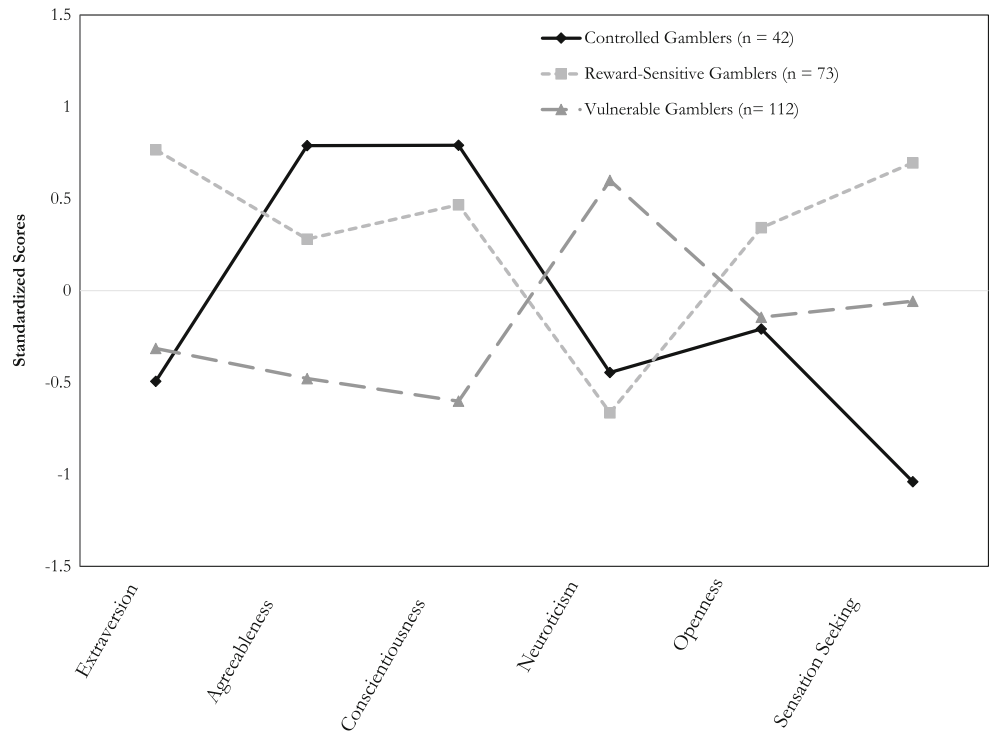
Limitations and Future Directions

Developmental research is required to understand changes across time in patterns of problematic behavior, and the entire span of adolescence (ages 13–17) is well-represented in the current study. Longitudinal research spanning several developmental periods, in combination with focal investigations examining large samples of circumscribed ages, will be crucial for understanding exactly how personality associations with gambling emerge over time. Longitudinal data is necessary to test the hypothesis, drawn from the current results, that vulnerable personality group members may be more likely to

Fig. 2 Structure of the Big Five Inventory and Brief Sensation Seeking Scale extracted using the "bass-ackwards" method (Goldberg 2006)
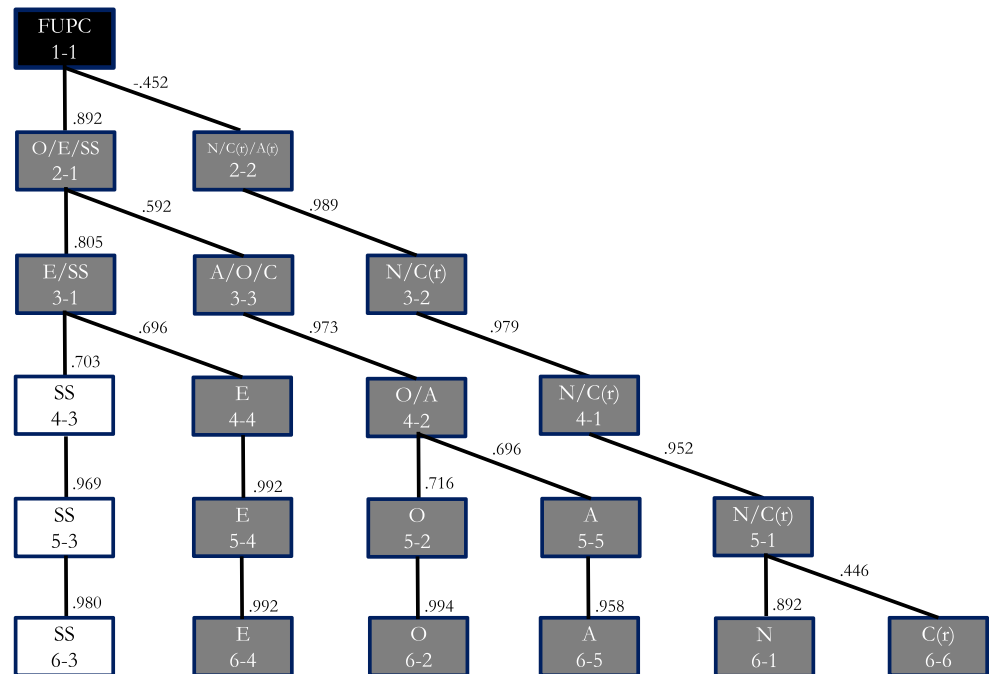
Table 4 Multiple regression results examining the components of personality hierarchy in predicting gambling severity, frequency, and motives

		Severity			Frequency		Motives		
	GPSS	DSM	Agg. Sev.	CAGI Freq.	Gam. Past 3 mos.		Enhance	Coping	Social
Level 1									
Personality	.19*	.08	.15*	.14	.01		.19*	.12	.21**
R^2	.04	.01	.02	.02	.00		.04	.01	.04
Level 2									
1: E/O/SS	.21**	.14	.20**	.17*	.05		.22**	.14	.23**
2: N/A(r)/C(r)	.00	.09	.05	.02	.07		.02	.02	.00
R^2	.04	.03	.04	.03	.01		.05	.02	.06
Level 3									
1: E/SS	.20**	.18*	.25**	.29***	.10		.28***	.11	.26**
2: N/C(r)	.00	.08	.04	−.02	.06		.00	.02	−.01
3: A/O/C	.02	−.01	.00	−.12	−.06		−.01	.08	.04
R^2	.07	.04	.06	.10	.02		.08	.02	.07
Level 4									
1: N/C(r)	.00	.07	.04	−.01	.02		.00	.00	−.01
2: A/O	.08	.00	.01	−.11	−.09		.00	.07	.05
3: SS	.19*	.19*	.25**	.29***	.23**		.28***	.16*	.26**
4: E	.09	.05	.09	.14	−.07		.12	−.01	.11
R^2	.05	.05	.07	.12	.07		.09	.03	.08
Level 5									
1: N	−.03	.05	.00	−.03	−.01		.00	−.02	−.02
2: O	.13	.08	.10	−.05	.01		.01	.10	.06
3: SS	.17*	.18*	.23**	.30***	.21**		.30***	.15	.26**
4: E	.07	.04	.08	.14	−.08		.12	−.02	.11
5: A/C	.00	−.07	−.07	−.09	−.14		.01	.01	.03
R^2	.05	.05	.08	.12	.07		.10	.03	.08
Level 6									
1: N	−.07	−.03	−.07	−.08	−.03		−.08	−.10	−.08
2: O	.14	.09	.11	−.04	.01		.03	.12	.08
3: SS	.15	.15	.20**	.28***	.21**		.27***	.11	.23**
4: E	.06	.02	.06	.13	−.08		.10	−.05	.10
5: A	.02	−.03	−.04	−.07	−.14		.05	.06	.06
6: C(r)	.07	.17*	.15*	.12	.05		.15*	.17*	.11
R^2	.06	.06	.09	.12	.07		.11	.07	.09

All regression coefficients are betas (standardized). Agg. Sev. = regression-based factor scores derived through Confirmatory Factor Analysis from the Canadian Adolescent Gambling Inventory (CAGI) severity and frequency items and the DSM-IV-MR-J items; DSM = total score for DSM-IV-MR-J; *GPSS* global problems severity subscale from the CAGI, *E* extraversion, *A* agreeableness, *C* conscientiousness, *N* neuroticism, *O* openness to experience, *SS* sensation seeking, *Enhance* enhancement motives, *Freq.* frequency, *Gam. past 3 mos.* gambled in the past 3 months; *p < .05. **p < .01. ***p < .001

develop problems related to pathological gambling later in life. Additionally, the supposition that severity and motive-based differences in gamblers, which were not found in the present study, may emerge later in life and be foreshadowed by differences in personality in adolescence, is a testable hypothesis deserving of careful future study.

The present study was conducted on a sample that was racially and ethnically diverse; however, the moderate sample size and the lower prevalence of some racial/ethnic subgroups (e.g., the sample was only 9.6% Asian) meant that there was not enough power to conduct analyses separately by subgroup. Previous research suggests differences in attitudes and behavior, as well as motives and parental/familial approval of gambling behaviors across cultures (Kessler et al. 2008; Raylu and Oei 2004). Thus, a larger diverse sample would be better positioned to investigate whether patterns of personality subgroups and the hierarchical structure of individual differences remains consistent across racial and ethnic subgroups.

The measure of gambling motives used in the present study included only three subscales and was adapted from a model originally constructed to assess drinking motives (Stewart and Zack 2008). Additional research incorporating a larger range of gambling specific motivations may help refine profiles associated with different classes of risk among adolescents. Similar approaches in longitudinal or cohort sequential designs would also be useful in identifying patterns associated with increasing severity over time and/or motivational transitions from positive (e.g., thrill and excitement) to negative reinforcement (escape, experiential avoidance, and coping).

Conclusions

The present study highlighted the importance of SS as a personality trait central to adolescent gambling behavior, and further found evidence for three classes of gamblers among a sample of adolescents selected for previous participation in gambling behaviors. The largest subgroup reflected a vulnerable personality class of adolescent gamblers with high N, low A, and low C. Evidence was also found for a controlled personality class and a reward-sensitive personality class. These three classes were not differentiable based on gambling severity or frequency; this highlights the critical importance of measuring personality to identify meaningful distinctions in subgroups of adolescent gamblers. Finally, hierarchical analyses suggested that the level containing six discrete components representing the FFM traits and SS was the most useful in predicting variance in gambling, with SS providing the greatest predictive power. Taken together, these results underline the importance of measuring personality traits broadly in adolescent gamblers. If assessed early, the specificity provided by differentiating between these classes may be especially useful in minimizing the detrimental health outcomes related with gambling problems later in life.

Compliance with Ethical Standards

Human Participants and/or Animals This research involved Human Participants. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards."

Informed Consent Informed consent was obtained from all individual participants included in the study.

Appendix

Full description of the content of the model resulting from the "bass-ackwards" extraction of a hierarchy

Level 2. At Level 2, the first component was defined by high loadings of items from the Extraversion and Openness to Experience Scales, as well as some Sensation-Seeking items. This component was labeled Approach. The second component was defined by high loadings of items from Neuroticism, as well as Agreeableness (reversed) and Conscientiousness (reversed). This component was labeled Avoidance.

Level 3. At Level 3, Approach split into a factor primarily defined by high loadings of items from Extraversion and Sensation-Seeking, labeled Reward, and a factor primarily defined by high loadings of items from Agreeableness, Openness to Experience, and Conscientiousness, labeled Adaptability. The level 2 component Avoidance was largely replicated at level 3, although primarily defined only by items from Neuroticism and Conscientiousness (reversed).

Level 4. At Level 4, Avoidance was again largely replicated, defined by items from Neuroticism and Conscientiousness (reversed), with some items from Agreeableness (reversed). The second component at this level replicates Adaptability from Level 3, with items from Agreeableness, Openness to Experience, and some from Conscientiousness. The third component at this level is defined almost entirely by Sensation-Seeking items, with one from Neuroticism (reversed). The fourth component is defined by Extraversion, with one item from Openness to Experience.

Level 5. At level 5, components emerge which are defined entirely by Sensation-Seeking, Extraversion, Openness to Experience. One of the remaining two components is a mixture of Neuroticism with some Conscientiousness (reversed), and the final component is almost entirely Agreeableness with two items from Conscientiousness and one from Openness to Experience.

Level 6. At Level 6, components emerge which are almost entirely homogenous (Neuroticism, Openness to Experience, Sensation-Seeking, Extraversion, Agreeableness, and Conscientiousness). There are only two exceptions: One item from Agreeableness (reversed) loads on the Neuroticism component, and one item from Conscientiousness loads on the Agreeableness component.

References

Bagby, R. M., Vachon, D. D., Bulmash, E. L., Toneatto, T., Quilty, L. C., & Costa, P. T. (2007). Pathological gambling and the five-factor model of personality. *Personality and Individual Differences, 43*, 873–880.

Blinn-Pike, L. (2017). Adolescent gambling: An update on research since 2010. *Journal of Adolescent Health, 60*, 481–482.

Blinn-Pike, L., Worthy, S. L., & Jonkman, J. N. (2010). Adolescent gambling: A review of an emerging field of research. *Journal of Adolescent Health, 47*, 223–236.

Braams, B. R., Peters, S., Peper, J. S., Güroğlu, B., & Crone, E. A. (2014). Gambling for self, friends, and antagonists: Differential contributions of affective and social brain regions on adolescent reward processing. *NeuroImage, 100*, 281–289.

Braams, B. R., van Duijvenvoorde, A. C. K., Peper, J. S., & Crone, E. A. (2015). Longitudinal changes in adolescent risk-taking: A comprehensive study of neural responses to rewards, pubertal development, and risk-taking behavior. Journal of Neuroscience, 35, 7226–7238.

Brunborg, G. S., Hanss, D., Mentzoni, R. A., Molde, H., & Pallesen, S. (2016). Problem gambling and the five-factor model of personality: A large population-based study: Personality and gambling problems. *Addiction, 111*, 1428–1435.

Canale, N., Vieno, A., Bowden-Jones, H., & Billieux, J. (2017). The benefits of using the UPPS model of impulsivity rather than the big five when assessing the relationship between personality and problem gambling: Letter to the editor. *Addiction, 112*, 372–373.

Carbonneau, R., Vitaro, F., Brendgen, M., & Tremblay, R. E. (2015). Variety of gambling activities from adolescence to age 30 and association with gambling problems: A 15-year longitudinal study of a general population sample. *Addiction, 110*, 1985–1993.

Cooper, M. L., Russell, M., Skinner, J. B., & Windle, M. (1992). Drinking motives questionnaire. *PsycTESTS.* https://doi.org/10.1037/t49575-000.

Cooper, M. L., Krull, J. L., Agocha, V. B., Flanagan, M. E., Orcutt, H. K., Grabe, S., et al. (2008). Motivational pathways to alcohol use and abuse among black and white adolescents. *Journal of Abnormal Psychology, 117*, 485–501.

Costa, P. T., & McCrae, R. R. (1992). Normal personality assessment in clinical practice: The NEO Personality Inventory. *Psychological Assessment, 4*, 5–13.

Delfabbro, P., Lahn, J., & Grabosky, P. (2006). Psychosocial correlates of problem gambling in Australian students. *Australian and New Zealand Journal of Psychiatry, 40*, 587–595.

Derevensky, J. L., & Gupta, R. (2000). Youth gambling: A clinical and research perspective. Journal of Gambling Issues. doi:https://doi.org/10.4309/jgi.2000.2.3.

Derevensky, J. L., Gupta, R., & Winters, K. (2003). Prevalence rates of youth gambling problems: Are the current rates inflated? *Journal of Gambling Studies, 19*, 405–425.

Dowling, N. A., Merkouris, S. S., Greenwood, C. J., Oldenhof, E., Toumbourou, J. W., & Youssef, G. J. (2017). Early risk and protective factors for problem gambling: A systematic review and meta-analysis of longitudinal studies. *Clinical Psychology Review, 51*, 109–124.

Fisher, S. (2000). Developing the DSM-IV criteria to identify adolescent problem gambling in non-clinical populations. *Journal of Gambling Studies, 16*, 253–273.

Forbes, M. K., Tackett, J. L., Markon, K. E., & Krueger, R. F. (2016). Beyond comorbidity: Toward a dimensional and hierarchical approach to understanding psychopathology across the life span. *Development and Psychopathology, 28*, 971–986.

Goldberg, L. R. (2006). Doing it all bass-Ackwards: The development of hierarchical factor structures from the top down. *Journal of Research in Personality, 40*, 347–358.

Goldstein, A. L., Faulkner, B., Cunningham, R. M., Zimmerman, M. A., Chermack, S., & Walton, M. A. (2013). A latent class analysis of adolescent gambling: Application of resilience theory. *International Journal of Mental Health and Addiction, 11*, 13–30.

Griffiths, M. D., & Parke, J. (2010). Adolescent gambling on the internet: A review. *International Journal of Adolescent Medicine and Health, 22*, 59–75.

Gupta, R., Nower, L., Derevensky, J. L., Blaszczynski, A., Faregh, N., & Temcheff, C. (2013). Problem gambling in adolescents: An examination of the pathways model. *Journal of Gambling Studies, 29*, 575–588.

Hopwood, C. J., Zimmermann, J., Pincus, A. L., & Krueger, R. F. (2015). Connecting personalnity structure and dynamics: Toward a more evidence-based and clinically useful diagnostic scheme. *Journal of Personality Disorders, 29*, 431–448.

Hoyle, R. H., Stephenson, M. T., Palmgreen, P., Lorch, E. P., & Donohew, R. L. (2002). Brief sensation seeking scale. *PsycTESTS.* https://doi.org/10.1037/t04251-000.

Hu, J., Zhen, S., Yu, C., Zhang, Q., & Zhang, W. (2017). Sensation seeking and online gaming addiction in adolescents: A moderated mediation model of positive affect associations and impulsivity. *Frontiers in Psychology, 8*. https://doi.org/10.3389/fpsyg.2017.00699.

Jackson, A. C., Dowling, N., Thomas, S. A., Bond, L., & Patton, G. (2008). Adolescent gambling behaviour and attitudes: A prevalence study and correlates in an Australian population. *International Journal of Mental Health and Addiction, 6*, 325–352.

John, O. P., Donahue, E. M., & Kentle, R. L. (1991). The big five inventory—Versions 4a and 54. Berkeley: University of California, Berkeley, Institute of Personality and Social Research. Retrieved from http://scholar.google.com/scholar?cluster=10512741042908091436&hl=en&oi=scholarr

Kessler, R. C., Hwang, I., LaBrie, R., Petukhova, M., Sampson, N. A., Winters, K. C., & Shaffer, H. J. (2008). DSM-IV pathological gambling in the National Comorbidity Survey Replication. *Psychological Medicine, 38*, 1351–1360.

Kim, H., & Eaton, N. R. (2015). The hierarchical structure of common mental disorders: Connecting multiple levels of comorbidity, bifactor models, and predictive validity. *Journal of Abnormal Psychology, 124*, 1064–1078.

King, S. M., Abrams, K., & Wilkinson, T. (2010). Personality, gender, and family history in the prediction of college gambling. *Journal of Gambling Studies, 26*, 347–359.

King, D. L., Delfabbro, P. H., Kaptsis, D., & Zwaans, T. (2014). Adolescent simulated gambling via digital and social media: An emerging problem. *Computers in Human Behavior, 31*, 305–313.

Korn, D. A., & Shaffer, H. J. (1999). Gambling and the health of the public: Adopting a public health perspective. *Journal of Gambling Studies*, 289–365.

Kushner, S. C., Quilty, L. C., Tackett, J. L., & Bagby, R. M. (2011). The hierarchical structure of the dimensional assessment of personality pathology (DAPP-BQ). *Journal of Personality Disorders, 25*, 504–516.

Mackinnon, S. P., Lambe, L., & Stewart, S. H. (2016). Relations of five-factor personality domains to gambling motives in emerging adult gamblers: A longitudinal study. *Journal of Gambling Issues, 34*, 179–200.

MacLaren, V. V., Fugelsang, J. A., Harrigan, K. A., & Dixon, M. J. (2011). The personality of pathological gamblers: A meta-analysis. *Clinical Psychology Review, 31*, 1057–1067.

MacLaren, V. V., Ellery, M., & Knoll, T. (2015). Personality, gambling motives and cognitive distortions in electronic gambling machine players. *Personality and Individual Differences, 73*, 24–28.

Mann, F. D., Engelhardt, L., Briley, D. A., Grotzinger, A. D., Patterson, M. W., Tackett, J. L., et al. (2017). Sensation seeking and impulsive traits as personality endophenotypes for antisocial behavior:

Evidence from two independent samples. *Personality and Individual Differences, 105*, 30–39.

Markon, K. E., Krueger, R. F., & Watson, D. (2005). Delineating the structure of normal and abnormal personality: An integrative hierarchical approach. *Journal of Personality and Social Psychology, 88*, 139–157.

McGrath, D. S., Neilson, T., Lee, K., Rash, C. L., & Rad, M. (2018). Associations between the HEXACO model of personality and gambling involvement, motivations to gamble, and gambling severity in young adult gamblers. Journal of Behavioral Addictions, 1–9.

Messerlian, C. (2005). Youth gambling problems: A public health perspective. *Health Promotion International, 20*, 69–79.

Miller, J. D., MacKillop, J., Fortune, E. E., Maples, J., Lance, C. E., Keith Campbell, W., & Goodie, A. S. (2013). Personality correlates of pathological gambling derived from big three and big five personality models. *Psychiatry Research, 206*, 50–55.

Neighbors, C., Lostutter, T. W., Cronce, J. M., & Larimer, M. E. (2002). Exploring college student gambling motivation. *Journal of Gambling Studies, 18*, 361–370.

Primi, C., Narducci, R., Benedetti, D., Donati, M., & Chiesi, F. (2011). Validity and reliability of the Italian version of the brief sensation seeking scale (BSSS) and its invariance across age and gender, *18*, 231–241.

Raylu, N., & Oei, T. P. (2004). Role of culture in gambling and problem gambling. *Clinical Psychology Review, 23*, 1087–1114.

Richard, J., & Derevensky, J. (2017). Identifying the relationship between mental health symptoms, probelm behaviors and gambling among adolescents. *Annals of Behavioural Science, 03*, 1–9.

Shaffer, H. J., & Korn, D. A. (2002). Gambling and related mental disorders: A public health analysis. *Annual Review of Public Health, 23*, 171–212.

Slutske, W. S., Caspi, A., Moffitt, T. E., & Poulton, R. (2005). Personality and problem gambling: A prospective study of a birth cohort of young adults. *Archives of General Psychiatry, 62*, 769–775.

Smith, G. T., Fischer, S., Cyders, M. A., Annus, A. M., Spillane, N. S., & McCarthy, D. M. (2007). On the validity and utility of discriminating among impulsivity-like traits. *Assessment, 14*, 155–170.

Soto, C. J., John, O. P., Gosling, S. D., & Potter, J. (2011). Age differences in personality traits from 10 to 65: Big five domains and facets in a large cross-sectional sample. *Journal of Personality and Social Psychology, 100*, 330–348.

Stewart, S. H., & Zack, M. (2008). Development and psychometric evaluation of a three-dimensional gambling motives questionnaire. *Addiction, 103*, 1110–1117.

Tackett, J. L., Quilty, L. C., Sellbom, M., Rector, N. A., & Bagby, R. M. (2008a). Additional evidence for a quantitative hierarchical model of mood and anxiety disorders for DSM-V: The context of personality structure. *Journal of Abnormal Psychology, 117*, 812–825.

Tackett, J. L., Silberschmidt, A. L., Krueger, R. F., & Sponheim, S. R. (2008b). A dimensional model of personality disorder: Incorporating DSM cluster a characteristics. *Journal of Abnormal Psychology, 117*, 454–459.

Tackett, J. L., Slobodskaya, H. R., Mar, R. A., Deal, J., Halverson, C. F., Baker, S. R., et al. (2012). The hierarchical structure of childhood personality in five countries: Continuity from early childhood to early adolescence. *Journal of Personality, 80*, 847–879.

Tackett, J. L., Rodriguez, L. M., Rinker, D. V., & Neighbors, C. (2015). A personality-based latent class analysis of emerging adult gamblers. *Journal of Gambling Studies, 31*, 1337–1351.

Tremblay, J., Stinchfield, R., Wiebe, J., & Wynne, H. (2010). *Canadian Adolescent Gambling Inventory (CAGI) Phase III Final Report* (technical report). Alberta gaming research institute. Retrieved from http://prism.ucalgary.ca//handle/1880/48158

Vachon, D. D., & Bagby, R. M. (2009). Pathological gambling subtypes. *Psychological Assessment, 21*, 608–615.

Veissière, S. P. L., & Stendel, M. (2018). Hypernatural monitoring: A social rehearsal account of smartphone addiction. *Frontiers in Psychology, 9*. https://doi.org/10.3389/fpsyg.2018.00141.

Weinstock, J., Whelan, J. P., & Meyers, A. (2008). College students' gambling behavior: When does it become harmful? *Journal of American College Health, 56*, 513–522.

Whiteside, S. P., & Lynam, D. R. (2001). The five factor model and impulsivity: Using a structural model of personality to understand impulsivity. *Personality and Individual Differences, 30*, 669–689.

Wright, A. G. C., & Simms, L. J. (2014). On the structure of personality disorder traits: Conjoint analyses of the CAT-PD, PID-5, and NEO-PI-3 trait models. *Personality Disorders: Theory, Research, and Treatment, 5*, 43–54.

Wright, A. G. C., Thomas, K. M., Hopwood, C. J., Markon, K. E., Pincus, A. L., & Krueger, R. F. (2012). The hierarchical structure of DSM-5 pathological personality traits. *Journal of Abnormal Psychology, 121*, 951–957.

Zuckerman, M., & Glicksohn, J. (2016). Hans Eysenck's personality model and the constructs of sensation seeking and impulsivity. *Personality and Individual Differences, 103*, 48–52.

Zuckerman, M., Eysenck, S., & Eysenck, H. J. (1978). Sensation seeking scale. *Form V. PsycTESTS.* https://doi.org/10.1037/t04065-000.